Tests on Keer Steam Turbine and Worthington Centrifugal Pump

S. V. James
I. F. Jackson

1907

621.16
J 23

ARMOUR
INST. OF TECH. LIB.
CHICAGO.

Illinois Institute
of Technology
Libraries

AT 78
James, Sydney Vincent
Tests on Kerr steam turbine
and direct-connected

922
J3c
Q

TESTS ON KERR STEAM TURBINE AND DIRECT-CONNECTED WORTHINGTON CENTRIFUGAL PUMP.

A THESIS

PRESENTED BY

Sydney Vincent James
and
Irving Foster Jackson

TO THE

PRESIDENT AND FACULTY

OF

ARMOUR INSTITUTE OF TECHNOLOGY

FOR THE DEGREE OF

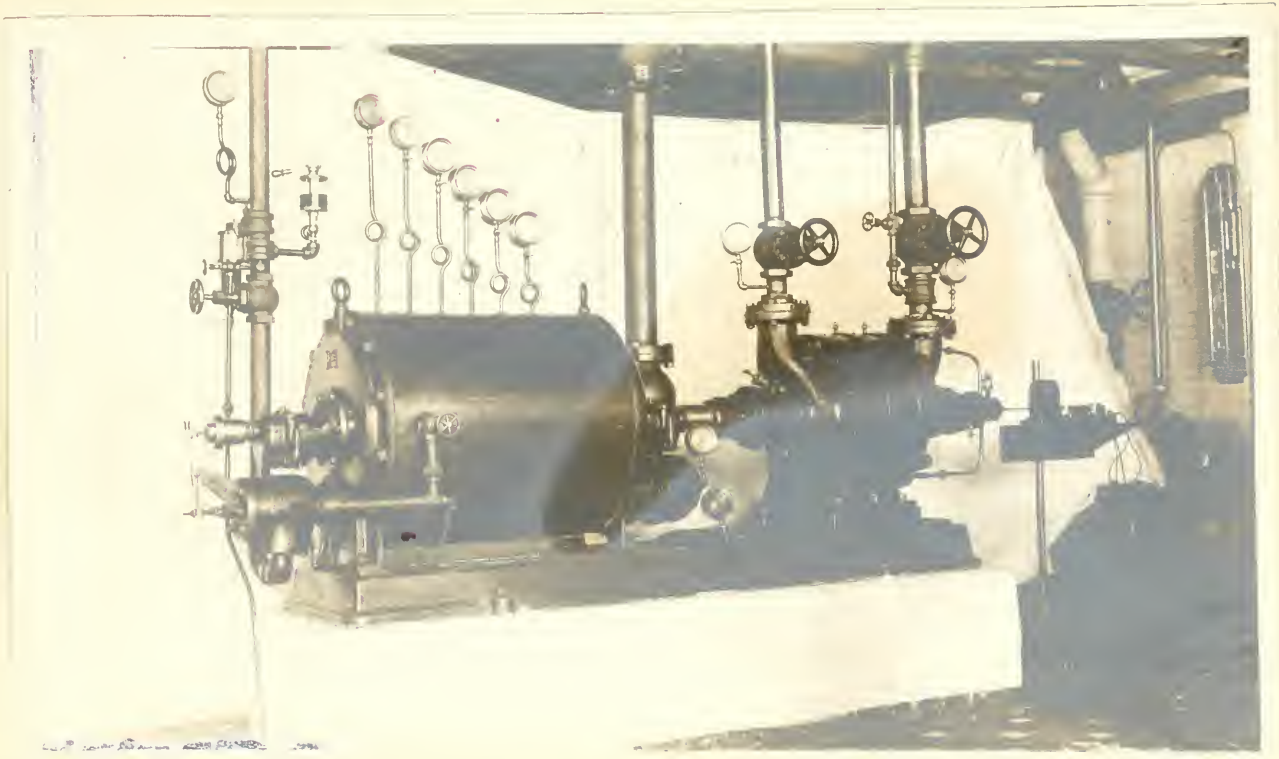
BACHELOR OF SCIENCE IN MECHANICAL ENGINEERING

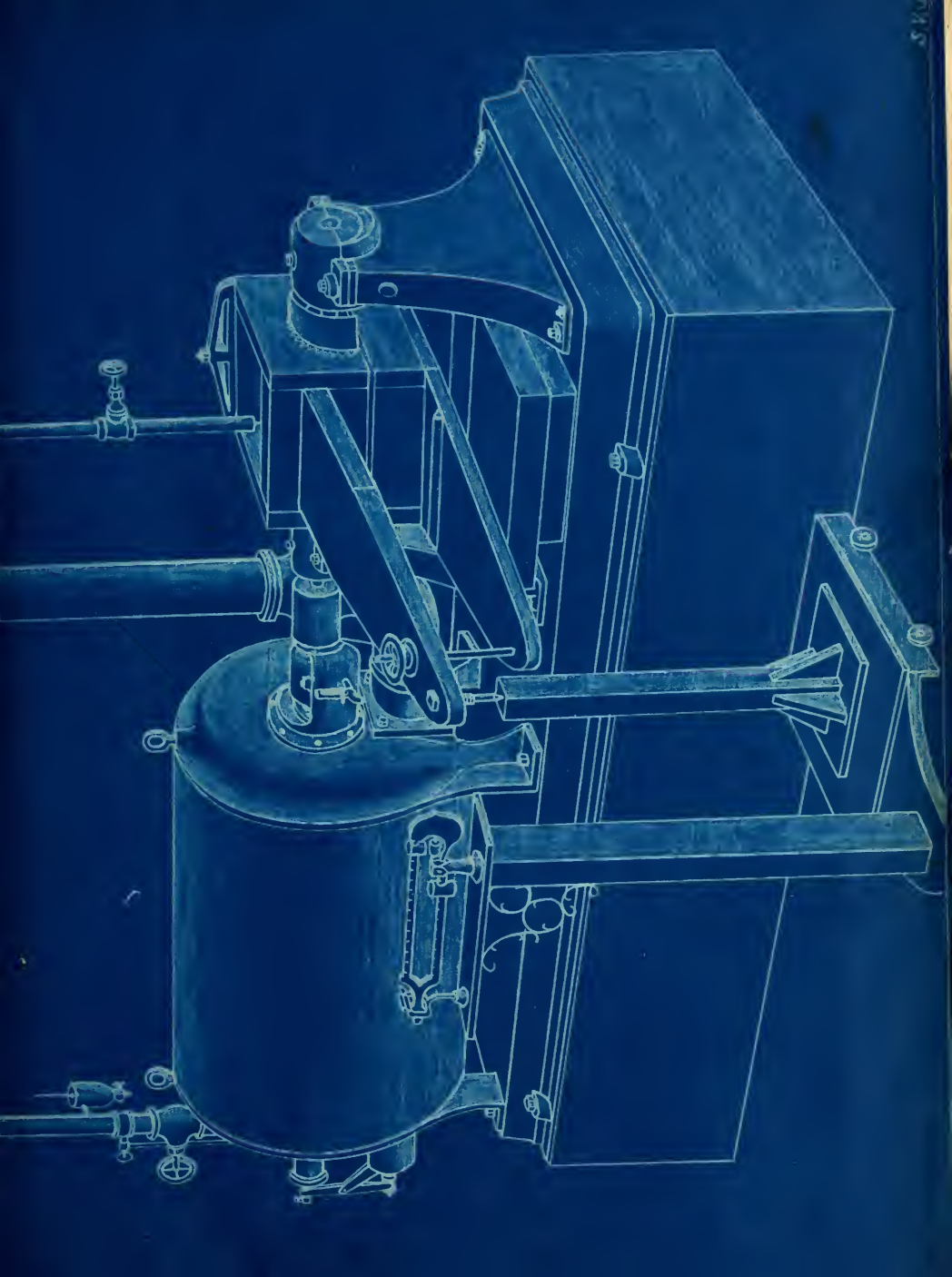
HAVING COMPLETED THE PRESCRIBED COURSE OF STUDY IN

MECHANICAL ENGINEERING

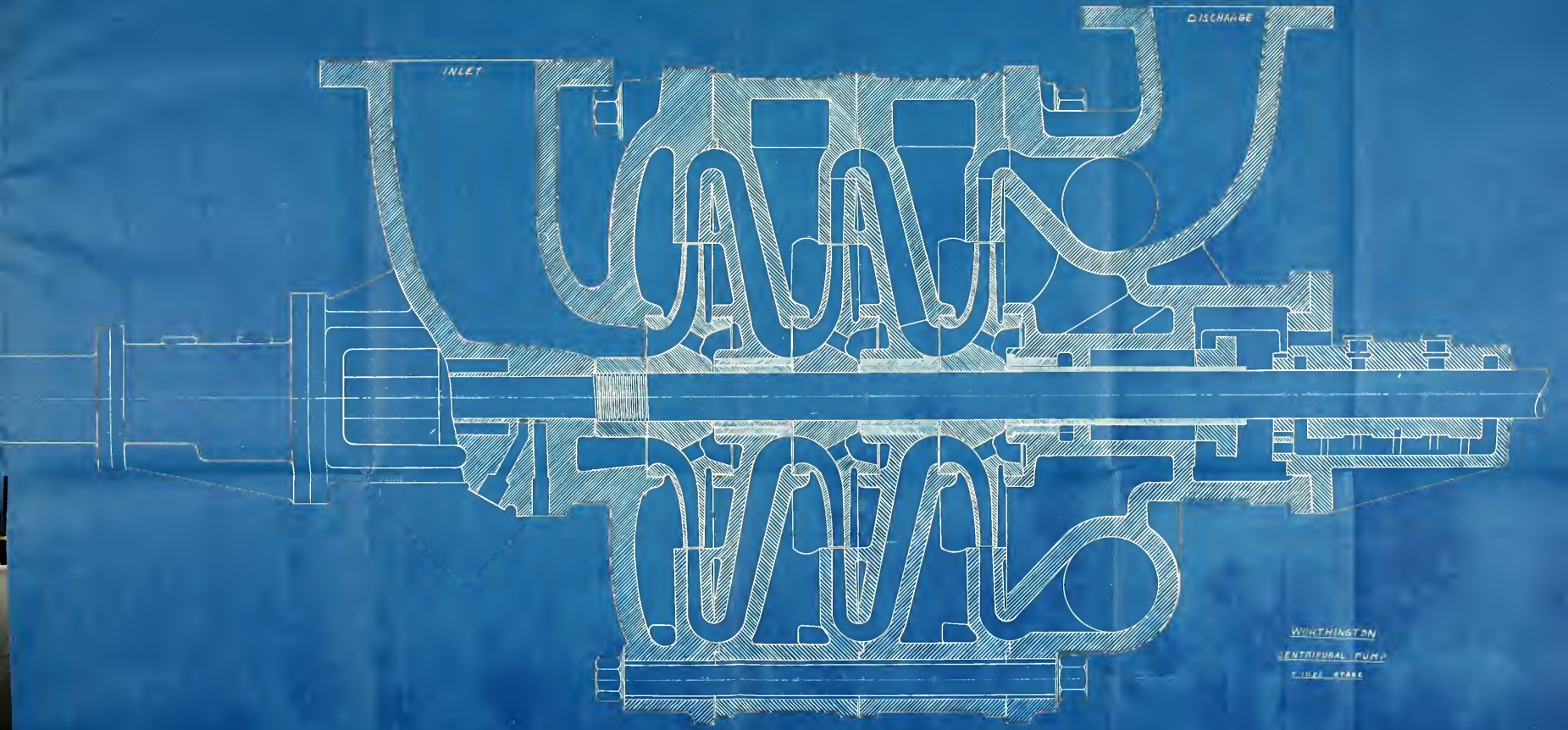
JUNE, 1907.

ILLINOIS INSTITUTE OF TECHNOLOGY
PAUL V. GALVIN LIBRARY
35 WEST 33RD STREET
CHICAGO, IL 60616





Test #3 52
Calibration Curve-Venturi Meter 53
Bibliography —


INLET
DISCHARGE
WORTHINGTON
CENTRIFUGAL PUMP
STAGE

CONTENTS.

	Page
Object of thesis	1
List of Apparatus	1
Description of Turbine	1
" " Brake	2
" " Pump and Piping	3
Method of Procedure	3
Tests on pump	4
Calibration of Instruments	5
Calculations	6
Discussion	8
Comparative Data	
Table *1	12
" *2	13
" *3	15
Data:- Brake tests	16 & 17
Steam flow tests	18
Venturi Meter Calibration	18
Kinetic H.P. Calculations	19
Final Turbine Data	20
Pump Tests	21
Curves:-	
Condensing- Abscissae- Pressures	22-28
" " Horse Powers	29-35
Non-Condensing- " Pressures	36-42
" " " Horse Powers	43-49
Pump Tests:-	
Test *1	50
Test *2	51
Test *3	52
Calibration Curve- Venturi Meter	53
Bibliography	—

621.16
J23

TESTS ON KERR STEAM TURBINE AND DIRECT-CONNECTED WORTHINGTON CENTRIFUGAL PUMP.

----------oo----------

OBJECT:- The object of this thesis was to make experimental investigations to determine:(a) concerning the Kerr Steam Turbine, the water rate, horse power, impulse efficiency and thermodynamic efficiency for various pressures and speeds; and (b) concerning the Worthington Centrifugal Pump, the capacity and efficiency for various speeds and heads.

APPARATUS:-Seven-Stage Kerr Steam Turbine, 18"; Three Stage Worthington Centrifugal Pump; Wheeler Condenser with air, and water pumps; Venturi Water Meter, 1¼" Throat.

Two Steel Cylindrical Weighing Tanks on platform scales.

Prony Brake attachment for turbine including 1 platform scales.

Throttling Calorimeter with thermometer.

Various pressure and vacuum gauges. Electric Tachometer.

The Kerr Steam Turbine is ofthe impulse type, closely resembling a Pelton Water Wheel in design. The machine experimented upon was designed to run at 2400 R.P.M. and at 100 pounds per square inch initial steam pressure. It was supposed to develop sufficient power to operate the Worthington Centrifugal Pump under its rated load. It has seven stages in each of which revolves a steel disk with double-cup buckets on the periphery. The steam impinges on the buckets from converging nozzles of such number and size that the pressure in each stage is approximately six tenths (0.6) of that in the preceding stage. The nozzles are arranged as follows:

19495

	Diameter in inches.	Number.
Stage No.1	.248	6
" " 2	.239	12
" " 3	.242	20
" " 4	.377	14
" " 5	.411	20
" " 6	.542	20
" " 7	.522	36

The turbine has a centrifugal governor consisting of two semi-cylindrical hollow steel weights (placed with their axes coinciding with the center of the shaft) operating a balanced valve in the steam chest thus controlling the steam supply to the turbine (Note:- For description of turbine and governor, see Engineer, Chicago, Apr.1, 1907.)

DESCRIPTION OF BRAKE:- The Prony Brake instead of being of the usual strap and block type was built in two parts of solid oak. The rotor was a soft steel drum about 12 inches long by 6 inches in diameter. The pressure between this drum and the oak brake was adjusted by means of a hand wheel, as may be seen from the drawing of turbine and brake. Water was used to cool the brake, the water passing through holes in the upper section and coming in contact with the drum along grooves which were cut in the brake parallel to the axis of rotation. The holes were bored at about $\frac{1}{2}$ inch pitch and the grooves cut at about one inch pitch.

Much difficulty was at first encountered because of the rapid heating of the brake and consequent stalling of the turbine. An attempt was made to remedy the trouble by lining the brake with sheet iron, but this was unsuccessful and the iron removed.

After continued operation for some time the brake became more satisfactory, though an abundant flow of water was at all times necessary. The difficulty of taking accurate readings became less as the tests progressed and the data may be depended on as being read with less than one percent of error. The brake constant varied slightly from day to day and was tabulated at the time of each experiment.

The pump was designed to operate at 2400 R.P.M. delivering 200 gallons per minute against a head of 150 lbs. per sq. inch. It has three stages in each of which is an impeller and stationary vanes suitably arranged to convert velocity head to pressure head. The diameter of the inlet pipe is 3 inches, and of the outlet pipe 2½ inches. The end thrust ~~on the shaft~~ is taken up by a water-cooled bearing on the inlet end of the bronze shaft.

The foundation of the unit is a special casting so constructed that either the pump or the Prony brake attachment can be mounted.

METHOD OF PROCEDURE:- (a) TESTS ON TURBINE.

Brake tests on the turbine were made both condensing at 15 inches vacuum, and non-condensing (0 lbs. per sq. in. gauge), at seven different speeds ranging from 3000 to 2400, to determine the horse power at steam chest pressures ranging from 50 to 100 lbs. per sq. in.. The various speed settings were obtained by adjustment of the governor. The actual speed was read on a voltmeter connected to a small direct current magneto generator, attached to the shaft. Gauges were located as follows:- (0-150) gauge on steam pipe, (0-300) on steam chest, a gauge communicating with each stage, one on the exhaust pipe at the turbine and a mercury column on the condenser. Twenty minute runs were made

to determine the weight of steam flowing thru the turbine at various steam chest pressures, ranging from 50 lbs. to 100 lbs. per sq. inch, by steps of 10 lbs.. During these tests motion of the turbine was prevented by having the brake clamped, and during each run the steam chest pressure was held constant by throttling. The steam was condensed and weighed in cylindrical steel weighing tanks on Fairbanks platform scales, the weight being checked by readings taken every five minutes during the run. These runs were made both condensing and non-condensing. During the runs the pressures in the various stages were recorded.

(B) TESTS ON PUMP.

The brake attachment, including two pedestals and shaft, was then removed and the pump mounted on the foundation. Water supply was led to the pump by a 3 inch pipe from a sump into which the water was discharged after leaving the high pressure side of the pump thru a 2½ inch pipe. Near the end of the discharge line was a Venturi meter, the diameter of the throat being 1½ inches. The pressures in the approach and throat of this meter were read by spring gauges. The supply pipe to the pump is about 110 feet long, having 4 bends in it and a foot valve on the end below water in the sump. The discharge pipe is about the same length as the supply pipe and has 6 bends.

When the pump was first driven, the bearing nearest the turbine gave considerable trouble by rapid heating. This difficulty was overcome after the brass was scraped and the shaft drawfiled on the scored parts. The best lubrication was effected by a mixture of equal parts engine and cylinder oils.

The pump tests were made with the turbine running condensing at 15 inches vacuum, and speeds of about 2400, 2500 and 2600 R.P.M. respectively. The discharge pressure was raised by throttling from the lowest obtainable to about 150 lbs. per sq. in. making in all about 9 points, and the corresponding suction pressure and Venturi gauge readings taken for each speed test.

CALIBRATION OF INSTRUMENTS:-

The tachometer and millivoltmeter were originally calibrated to read directly in R.P.M. up to 1000. In order to obtain readings up to the speed of the turbine a resistance box was inserted in series with the tachometer and millivoltmeter and resistance added till the movement of the needle was within the range of the scale for a speed of 3000 R.P.M. The millivoltmeter was then calibrated with a hand speed counter, it being found that with a resistance of 9500 ohms the actual R.P.M. was 3.154 times the reading of the millivoltmeter.

The Venturi meter was calibrated at the Underwriters Laboratory, Chicago, because of the limited facilities at the Institute. Professor Taylor very kindly gave his own assistance and the use of the Nozzle Meter. Calibration curves for the nozzle were supplied and the discharge in gallons per minute was read directly off the curves. The Venturi meter was calibrated with discharges ranging from 118 to 295 gal. per min. The curve of Calibration was then plotted between the discharge and the fall in pressure read in pounds per square inch at the meter. For most runs the pressure was so low that a vacuum gauge was used on the throat.

All pressure gauges were calibrated by means of the Crosby Gauge Tester. Vacuum gauges were calibrated by comparison with a mercury

column on the Wheeler Condenser.

Thermometer #2 was used in the Calorimeter and was found on calibration to read ½ degree low through range used.

CALCULATIONS:-

An outline of the calculations made and where they may be found will here be given. From the data taken during the turbine tests the calculations made amount to a complete calibration of the machine. The data sheets, pages ..16..17.. show the results recorded in the laboratory, together with the brake horse power (B.H.P.) for each point, both condensing and non-condensing. The total weight of steam per hour for the various pressures is shown on page ..18.. These figures were plotted against the steam chest pressures and a smooth curve drawn, then the weights corresponding to the pressures were taken from the curve and tabulated on same page with the observed data. These figures were used to find the water rate per B.H.P. per hour by dividing the total weight per hour by the corresponding B.H.P.. The pressures in the different stages are also shown on page ..18....

On page ..19.. is the data leading to the theoretical horse power calculations. Adiabatic throttling is assumed from pipe pressure to the pressure just beyond the throttle valve. The various items from the steam tables corresponding to the steam chest pressures (corrected and converted to absolute) were found, and in the data are denoted by subscript "1". Those for pipe pressures are subscribed "0". The total heat in a pound of steam at pipe pressure is $x_0 r_0 - q_0$, while that at the reduced pressure past the valve is $x_1 r_1 - q_1$, X being found by assuming no heat lost,

hence ~~that~~ the equation

$$x_0 r_0 + q_0 = x_1 r_1 + q_1$$

holds for the matter in hand. Thus the heat of a pound of the steam entering the turbine proper was calculated. Then knowing $x_1 r_1 + q_1$, the heat at the back pressure was calculated by assuming an adiabatic expansion in the nozzles. We are justified in this assumption by the fact that at no time the outside casing of the turbine was too hot for comfortable contact with the hand. The equation used was

$$\frac{x_1 r_1}{T_1} + \theta_1 = \frac{x_2 r_2}{T_2} + \theta_2 .$$

In the data $x_1 r_1 + q_1$ is denoted as H_1, and $x_2 r_2 + q_2$ as H_2. Finally $H_1 - H_2$ is the heat given up to work by each pound of steam. Knowing the weight of steam flowing per second the horse power equivalent is found by the expression

Kinetic Horse Power (K.H.P.) =

$$\frac{m v^2}{2 \times 550} = \frac{w v^2}{2g \times 550} = \frac{w 2g (H_1 - H_2) 778}{2g \times 550} = \frac{w (H_1 - H_2) 778}{550}$$

where M = mass of steam flowing per second,

W = weight " " " " " ,

V = velocity of steam due to difference of heat $(H_1 - H_2)778$ expressed as foot pounds,

778 = mechanical equivalent of heat,

550 = factor converting foot-lbs. per sec. to horse power.

Page 20 shows the assembled turbine data. The corrected water rate was found by multiplying the actual by the quality taken by the calorimeter on the steam pipe. The thermodynamic

efficiency was calculated according to the British Code, i.e., above the heat of the liquid at the exhaust pressure; or

$$\text{Thermodynamic Eff.} = \frac{2545}{\text{(actual water rate)} \times (x_1 r_1 + q_1 - q_4)}.$$

The impulse efficiency is ~~the efficiency of the nozzles and buckets or in other words, it is~~ the ratio of the horse power actually developed (B.H.P.) to the theoretical horse power (K.H.P.).

The data for the pump tests is shown on page 24. All pressures given are corrected for gauge calibration. The gallons per minute pumped were found by knowing the meter head and interpolating on the curve of meter calibration on page 53. The horse power input to the pump was found by taking turbine curves corresponding to the average speeds and back pressure used on turbine tests and interpolating with the steam chest pressure on the horse power curves. The horse power output was determined from the known amount of water raised against the known discharge pressure; it equals the weight lifted per minute multiplied by the head and divided by the factor 33000. The ratio of the horse power output to the horse power input is the efficiency of the pump.

DISCUSSION OF RESULTS:-

The variation of the efficiency of the turbine may be seen in the accompanying curves. Considering the curves of efficiency, horse power and water rate, plotted against steam chest pressure as abscissa:- The turbine gave its highest thermodynamic efficiency, when running condensing, at speeds from 2800 to 3000

R.P.M.. At these speeds with 90 to 100 pounds steam chest pressure the thermodynamic efficiency was about 5.5 per cent. As the speed dropped to 2400 R.P.M. the efficiency at these pressures gradually fell to about 5.1 per cent.. The non-condensing runs showed the best thermodynamic efficiency at speeds ranging from 2850 to 2500 R.P.M., being lower for speeds above or below these values. The impulse efficiency for condensing runs was best at the higher speeds and the average maximum was obtained with a steam chest pressure of 81 pounds, ~~for condensing runs.~~

Non-condensing the turbine gave the best impulse efficiency at speeds of 2800 to 2500 R.P.M. at 100 pounds steam chest pressure. Water rate followed the same general trend as the efficiencies, being best for the higher speeds, condensing, and at 100 pounds steam pressure. Non-condensing the water rate was lowest at speeds between 2800 and 2500 R.P.M..

In all cases the B.H.P. developed was almost directly proportional to the steam chest pressure, the horse power curve being nearly a straight line. Curves at speeds 2700, 2600, & 2400 show a tendency to droop, this being more noticable in the condensing, than the non-condensing runs. Curves of efficiencies and water rates, plotted against horse power, have the same general characteristics as those plotted against pressure. This is more nearly true of the non-condensing runs than of the condensing, because of the horse power curves for non-condensing runs being more nearly straight lines. This makes the horse power approximately equal to a constant times the steam chest pressure plus a constant. This seems to be quite a universal characteristic of small

turbines with this type of valve and is used by the De Laval Co. for estimating horse power. (Note:- See Power, June 1904)

Tests on the centrifugal pump were all made with the suction valve wide open, for it was found that the friction due to the small size of the suction pipe (3") would not allow variation in the suction head. With a discharge of 200 gal. per min. or over, the friction in the supply pipe was so great that 24 to 25 inches of vacuum were indicated on the suction gauge. The maximum water discharged was 230 gallons per minute with a suction of 24.2 inches and a total lift of 125.4 pounds. It is seen, therefore, that about 225 gallons per minute is all that the suction will supply to the pump, and that any reduction in discharge head will not much increase the quantity discharged.

The first run was made at about rated speed, the actual range being 2360 - 2395 R.P.M.. The turbine was run condensing with 15 inches of vacuum. The discharge head was varied from 150 pounds per square inch to the minimum possible, ~~of~~ 35.5 pounds. The corresponding discharge varied from 126 to 192.5 gal. per minute, and the suction head from 13.7 to 22.3 inches of mercury. The best efficiency, 46.5% was obtained with 149.7 pounds total lift, and 162.5 gal. per min. discharge.

The second run was made with speed ranging from 2440 to 2500 R.P.M. and slightly better results were obtained. The best efficiency, as taken from the curve, was 49% at 157 pounds total lift and 179 gal. per min. discharge. At this speed the minimum discharge head was 34.5 pounds and the maximum 155 pounds. The suction head varied from 24.2 to 18.7 inches of mercury.

The third run, at over 2600 R.P.M., gave the best results though difficulty in taking simultaneous reading made it the least accurate. When discharging at high heads the load on the turbine was so great that the vacuum could not be kept at 15 inches. It was therefore necessary to run the turbine at light load till the vacuum was several inches too high. Then quickly throttling the discharge and thus raising the head, readings were taken at the instant the gauge needle indicated 15 inches vacuum on the turbine. The maximum total lift during this run was 166.27 pounds and the corresponding discharge 225 gal. per min.. This reading also gave the best pump efficiency obtained, 57.3 per cent.. The curve indicates that the discharge might have been throttled to a still higher lift, and given a better efficiency, but inability of the turbine to carry the load made further readings impossible.

In conclusion it is seen that both pump and turbine gave the best results at considerably over rated speed, which was 2400 R.P.M.. It is difficult to find comparative data, but there are some tests recorded in the A.S.M.E. Transactions for Dec.1905 for a 10 horse power De Laval Turbine at Purdue University. The steam pressure at the boiler was 130 pounds, but the values at the turbine were varied from 17 to 127, back pressure atmospheric. The following table shows these results:

TABLE 1.

	No.	B.H.P.	Pressure	Steam per B.H.P. hr.
	1	0.00	17.1	-------
	2	1.63	42.2	128.6
	3	2.36	48.5	99.8
	4	2.97	55.6	85.7
4 nozzles in action	5	3.46	61.9	79.6
	6	4.38	70.8	71.5
	7	5.10	76.9	64.4
	8	7.52	99.6	53.6
	9	8.24	104.4	51.3
	10	10.33	126.3	47.8
	11	0.00	31.3	-------
	12	3.95	83.6	67.8
3 nozzles in action	13	4.77	93.4	60.0
	14	6.50	111.7	53.3
	15	0.00	42.2	-------
	16	1.95	83.5	83.4
2 nozzles in action	17	3.43	121.1	65.0
	18	3.87	127.0	59.3

In these tests the results realized are slightly better than those we obtained with the Kerr Turbine. The following figures are the data for tests made on a Kerr Turbine at the Kerr Shops:

TABLE 2.

Results of Tests made in the Kerr Shops, of an 18" 60 H.P. Kerr St. Turbine. 1907.

TESTS

12 - 10 - 11 - 06.

Condensing 26"

t	Duration	R.P.M.	Brake Gross	Brake Tare	Brake Net	B.H.P.	St.Chest Press.	Steam per hr	Steam per B.H.P. per hr.
	1	----	-----	---	---	----	125.0	2206	-----
	1	3096	66	20.75	45.25	66.4	99.5	1749	26.35
	1	3108	62	"	41.75	61.5	89.5	1655	26.9
	1	3116	55	"	34.75	51.3	74.5	1471	28.65
	1	3168	44.25	"	23.50	35.3	49.7	1061	30.1
	1	3193	33	"	12.25	18.55	25.0	724	39.0

Non-condensing

3034	44	20.75	23.25	33.4	99.5	1749	52.3
2474	47.5	"	26.75	31.4	99.5	1749	55.7
3084	40.25	"	28.50	28.5	89.5	1655	58.1

Stage Pressures

t No.	Steam Chest	#1	2	3	4	5	6	Exh.
1	90	40	19	5.5	3"	13"	20"	26"
2	125	58	30	12	1	9.5	17.5	26"
3	100	45	22	7.5	1	12	19	26"
4	75	32	14	2.75	5.5	14.5	21.5	26"
5	50	18.5	5	2.75	10	18	23	26"
6	25	6.5	2"	11"	16"	21"	24	26"

The results non-condensing for water rates are approximately the same as ours, perhaps a trifle lower. Since our condensing runs were made with 15" vacuum, it is difficult to find comparative figures. The condensing runs on the Kerr Turbine in Table 2, were made at 26" vacuum and show a much better economy - between 26 and 30 pounds per B.H.P.. Tests on some small De Laval machines gave about 25 pounds per B.H.P. economy. (See Engineering, Dec.29, 1905, P.880)

Comparative data on pump tests is also difficult to obtain. The following table, however, will indicate the results of tests on a De Laval Pump of 1700 gallon capacity at 100 foot lift. These figures show a higher efficiency (about 74%) than we obtained with the Worthington Pump.

TABLE 3.

Steam Pressure below gov.	Vacuum	R.P.M.	B.H.P.	Steam per B.H.P. hour	Duty per 1000 B.T.U.	Suction "Hg.	Water H.P.	Total Head ft.	Gal. per min	% Eff.
155.2	25-7/16	1553	59.6	24.06	61.5	14-27/32	44.51	94.9	1860	74.7
153.5	25¼	1547	58.9	24.21	61.26	13⅞	44.55	100.37	1759	75.6
150.7	25¼	1540	57.7	24.33	60.00	12-9/16	43.59	106.94	1615	75.5
143.5	25½	1549	54.8	24.53	54.47	9½	40.72	115.46	1398	74.3
161	25⅜	1570	57.5	24.5	37.43	6-1/16	31.80	125.85	1001	67.6
126	25¼	1547	57.7	25.45		16⅛	22.98	45.97	1978	48.1
70	25-7/16	1565	24.9			5¼		142.15		
169.5		1537			45.15	14¼	43.85	95.14	1826	
169.		1535			45.12	13⅛	43.82	99.05	1753	
169.7		1538			44.62	12-3/16	42.93	104.42	1629	
148.	25-9/16	1536	56.65	2442	50.64	15-19/32	34.95	70.72	1558	61.7
124.	26	1565	24					142.15		

e Laval Pump #1977, Type L.P.-S.

apacity 1700 gal. at 100 ft. head.

.P.M. 1500

ize of Suction Pipe 8"

ize of Discharge pipe 8"

eference - Power; June, 1904.

I. BARO. 28.85 BRAKE CONST. 20.6#

	CONDENSING					NON-CONDENSING			
STEAM CHEST PRESSURE	TOTAL LOAD #	NET LOAD #	R.P.M.	B.H.P.	Vacuum "Hg.	TOTAL LOAD	NET LOAD	R.P.M.	B.H.P
50	32.0	11.4	3015	16.38	15.25	26.6	6.0	2987	8.54
60	35.4	14.8	2980	21.0	15.5	29.5	8.9	2975	12.6
70	39.2	18.6	2960	26.2	15.6	32.3	11.7	2965	16.5
80	42.2	21.6	2930	30.15	15.4	35.0	14.4	2945	20.2
90	46.2	25.6	2935	35.8	15.5	37.5	16.9	2940	23.65
100	48.7	28.1	2920	39.1	14.5	41.2	20.6	2900	28.45
		Av.	2957				Av.	2952	

II. BARO 28.85 BRAKE CONST. 20.6#

50	32.1	11.5	2920	16.0	15.0	27.3	6.7	2945	9.4
60	36.0	15.4	2870	21.1	15.25	30.2	9.6	2925	13.37
70	39.1	18.5	2860	25.2	15.25	33.0	12.4	2900	17.14
80	42.8	22.2	2855	30.2	15.25	35.8	15.2	2873	20.8
90	46.2	25.6	2846	34.7	15.0	38.7	18.1	2860	24.6
100	49.6	29.0	2832	39.1	14.5	42.5	21.9	2840	29.6
		Av.	2864				Av.	2890	

II. BARO. 29.6 BRAKE CONST. 19.8#.

50	32.5	12.7	2825	17.1	15.25	27.5	7.7	2810	10.3
60	36.4	16.6	2780	22.0	15.0	30.4	10.6	2795	14.1
70	40.0	20.2	2750	26.5	15.25	34.4	14.6	2785	19.35
80	42.5	22.7	2745	29.7	15.0	36.0	16.2	2780	21.45
90	46.8	27.0	2737	35.2	15.25	39.7	19.9	2750	26.05
100	50.0	30.2	2720	39.15	15.25	42.4	22.6	2725	29.35
		Av.	2759				Av.	2774	

V. BARO. 29.5 BRAKE CONST. 20.2#.

50	32.4	12.2	2728	15.85	14.75	28.0	7.8	2760	10.25
60	36.4	16.2	2726	21.0	14.75	30.8	10.6	2735	13.8
70	40.4	20.2	2720	26.15	15.25	33.2	13.0	2720	16.85
80	42.9	22.7	2700	29.2	15.25	36.0	15.8	2710	20.4
90	47.0	26.8	2680	34.2	15.0	38.8	18.6	2708	24.0
100	49.7	29.5	2665	37.4	15.0	42.2	22.0	2690	28.2
		Av.	2703				Av.	2720	

V. BARO. 28.95 BRAKE CONST. 19.8*

STEAM CHEST PRESSURE	TOTAL LOAD	NET LOAD	R.P.M.	B.H.P	Vacuum "Hg.	TOTAL LOAD	NET LOAD	R.P.M.	B.H.P
50	32.7	12.9	2620	16.1	15.0	28.0	8.2	2635	10.3
60	36.1	16.3	2615	20.3	15.0	31.3	11.5	2630	14.4
70	40.3	20.5	2606	25.4	15.3	33.8	14.0	2600	17.3
80	44.3	24.5	2600	30.3	15.25	36.8	17.0	2592	21.0
90	47.5	27.7	2595	34.2	15.0	40.5	20.7	2588	25.5
100	49.5	29.7	2588	36.6	15.0	43.0	23.2	2540	28.6
		Av.	2604				Av.	2597	

VI. BARO. 29.05 BRAKE CONST. 19.7*

50	33.6	13.9	2530	16.75	15.25	28.6	8.9	2533	10.74
60	37.4	17.7	2520	21.25	15.25	31.5	11.8	2527	14.2
70	41.2	21.5	2510	25.7	15.25	34.4	14.7	2508	17.55
80	44.7	25.0	2505	29.8	15.0	38.1	18.3	2492	21.7
90	48.2	28.5	2490	33.8	15.0	40.8	20.1	2475	23.65
100	51.3	31.6	2470	37.2	15.0	44.2	24.5	2460	28.7
		Av.	2504				Av.	2499	

VII. BARO. 29.2 BRAKE CONST. 20.0*

50	34.0	14.0	2415	16.1	15.0	28.5	8.5	2410	9.75
60	37.0	17.0	2400	19.45	15.0	31.4	10.4	2395	11.86
70	41.3	21.3	2382	24.2	15.25	35.0	15.0	2383	17.05
80	45.3	25.3	2370	28.55	15.25	37.8	17.8	2370	20.1
90	49.3	29.3	2360	32.9	15.0	41.7	21.7	2350	24.3
100	50.5	30.5	2355	34.2	15.0	43.4	23.4	2340	26.1
		Av.	2380				Av.	2375	

STEAM FLOW TESTS.

CONDENSING

STEAM CHEST PRESS.	STAGE #1	#2	#3	#4	#5	#6	#7	Cal. Temp.	Total Wt. Condensed per hour	Wt. from Curve.
50	18.5	6.0	4.4"	10.4	13.7	14.7	14.95	211	1014.0	1018
60	24.5	11.6	0	9.0	12.7	14	14.8	211	1177.5	1157
70	28.8	14.5	0	7.8	12.5	14	14.9	211	1307.2	1310
80	33.8	17.0	0	6.4	12.2	14.1	15.0	212	1465.5	1462
90	39.6	20.0	1.5"	4.7	11.2	13.4	14.7	211	1626.0	1626
100	—	—	—	—	—	—	—	211	1779.0	1783
		STAGE PRESSURES CORRECTED.								
NON-CONDENSING										
50	19.0	10.8	5.5	3	0	0	0	211	986	996
60	23.0	13.5	7.7	3.5	2.2	0	0	218	1153.5	1145
70	30.0	16.2	8.1	3.8	2.1	0	0	"	1288.5	1295
80	35.0	18.4	9.5	5.6	3.5	2.6	0	"	1440	1444
90	—	—	—	—	—	—	—	"	1602	1600
100	—	—	—	—	—	—	—	"	1735.5	1752

VENTURI METER CALIBRATION

VENTURI METER				Diff. press #/□"	NOZZLE METER			√Diff Press.	Cu. ft. sec.	√Head ft. water	Head ft. H_2O	Coeff. C
UPSTREAM P Rec.	Corr.	Throat P. Rec.	Corr.		Press.	Diam. Tip	Gals min.					
26	27.3	26.5"	26.1"	40.1	10	1 3/4"	295	6.33	.657	9.61	92.5	1.00
12.8	13.5	16.6"	16.35"	21.5	10	1 1/2"	213	4.67	.474	7.05	49.7	0.985
10.3	12.2	5.9"	5.85"	15.05	10	1 3/8"	177	3.87	.394	5.89	34.75	0.978
9.6	11.6	1.3"	1.3"	10.3	10	1 1/4"	147	3.21	.327	4.87	23.8	0.981
9.5	11.5	3.9"	4.25"	7.25	10	1 1/8"	118.5	2.69	.264	4.09	16.75	0.944
15.3	17.4	1.5"	2"	15.4	15	1 1/4"	180	3.92	.400	5.96	35.6	0.983
16.0	18.1	8"	7.9"	22.0	15	1 3/8"	218	4.68	.485	7.11	50.75	0.999
25.3	27.6	3"	3.4"	24.2	25	1 1/4"	232	4.92	.516	7.47	55.9	1.012
25.4	27.7	11"	11.2"	16.5	25	1 1/8"	187	4.06	.416	6.17	38.1	0.989
27.2	29.6	13.3"	13.1"	36.04	25	1 3/8"	280	6.0	.623	9.12	83.2	1.00

KINETIC HORSE POWER CALCULATIONS.

CONDENSING.

BARO 29.2 = 14.35 #/□" = 210.8° F.

Steam Chest P. (P_1)	Pipe Press. Actual	Pipe Press Corr.	Pipe Press. Abs. P_0	X_0	r_0	q_0	r_1	q_1	θ_1
50	75	77.6	91.95	96.35	888.4	291.6	905.9	266.6	.4328
60	75	77.6	91.95	96.35	888.4	291.6	899.15	276.36	.4457
70.3	85	88	102.35	96.0	882.7	299.3	892.8	285.6	.4576
80.5	90	93.3	107.65	95.9	880.0	303.5	886.7	294.0	.4693
91.0	95	98.5	112.85	95.8	877.4	307.2	881.1	301.9	.4784
101.3	100	103.8	118.15	95.6	874.8	310.8	875.9	309.3	.4875

T_1	$X_1 r_1$	$\frac{X_1 r_1}{T_1}$	$\theta_1 - \theta_2$	$\frac{X_2 r_2}{T_2}$	$X_2 r_2$	H_2	H_1	$H_1 - H_2$	K.H.P.
758	880.5	1.161	.1734	1.3344	852	997.7	1147.1	149.4	59.8
767.5	870.74	1.134	.1863	1.3203	843	988.7	1147.1	158.4	72.1
776.5	861.7	1.110	.1982	1.3082	835	980.7	1147.3	166.6	85.8
784.6	853.5	1.088	.2100	1.2980	829	974.7	1147.5	172.8	99.2
792.1	845.3	1.068	.2190	1.2870	822	967.7	1147.2	179.5	114.7
799.1	838.0	1.050	.2281	1.2781	816	961.7	1147.3	185.6	130.0

$P_2 = 7.07$ #/□" $T_2 = 638$ $q_2 = 145.7$ $\theta_2 = .2594$

NON-CONDENSING.

ON 50# RUN BARO. 29.3
ON OTHERS " 29.05

Steam Chest P (P_1)	Pipe Press. Actual	Pipe Press Corr.	Pipe Press. Abs. P_0	X_0	r_0	q_0	$X_0 r_0$	$q_0 - q_1$	$X_1 r_1$
50	75	77.6	92.0	96.35	888.4	291.6	857	25	882.0
60	80	82.8	97.05	96.6	885.6	295.6	855	19.24	874.24
70.3	80	82.8	97.05	96.6	885.6	295.6	855	10.0	865.0
80.5	90	93.3	107.55	96.25	880.1	303.4	847.5	9.4	856.9
91.0	96	99.7	113.95	96.1	876.8	308.0	842.5	6.1	848.6
101.8	98	101.8	116.05	96.05	875.8	309.4	841.0	0	841.0

$\frac{X_1 r_1}{T_1}$	$\theta_1 - \theta_2$	$\frac{X_2 r_2}{T_2}$	$X_2 r_2$	H_2	H_1	$H_1 - H_2$	K.H.P.		
1.164	.1216	1.2856	863	1042.7	1148.6	105.9	41.4	14.4	1425
1.139	.1353	1.2743	855	1034.1	1150.6	116.5	52.4	$q_2 = 179.7$	179.1
1.115	.1472	1.2622	846.5	1025.6	1150.6	125.0	63.6	$\theta_2 = .3112$	.3104
1.092	.1589	1.2509	840	1018.1	1150.9	131.8	74.7	$T_2 = 671.7$	671.2
1.072	.1680	1.2400	832	1011.1	1150.5	139.4	87.6		
1.052	.1771	1.2291	825	1004.1	1150.4	146.3	100.5		

29.3 "Hg = 14.40 #/□" = 210.8° F
29.05 "Hg = 14.25 #/□" = 210.5° F

FINAL TURBINE DATA.

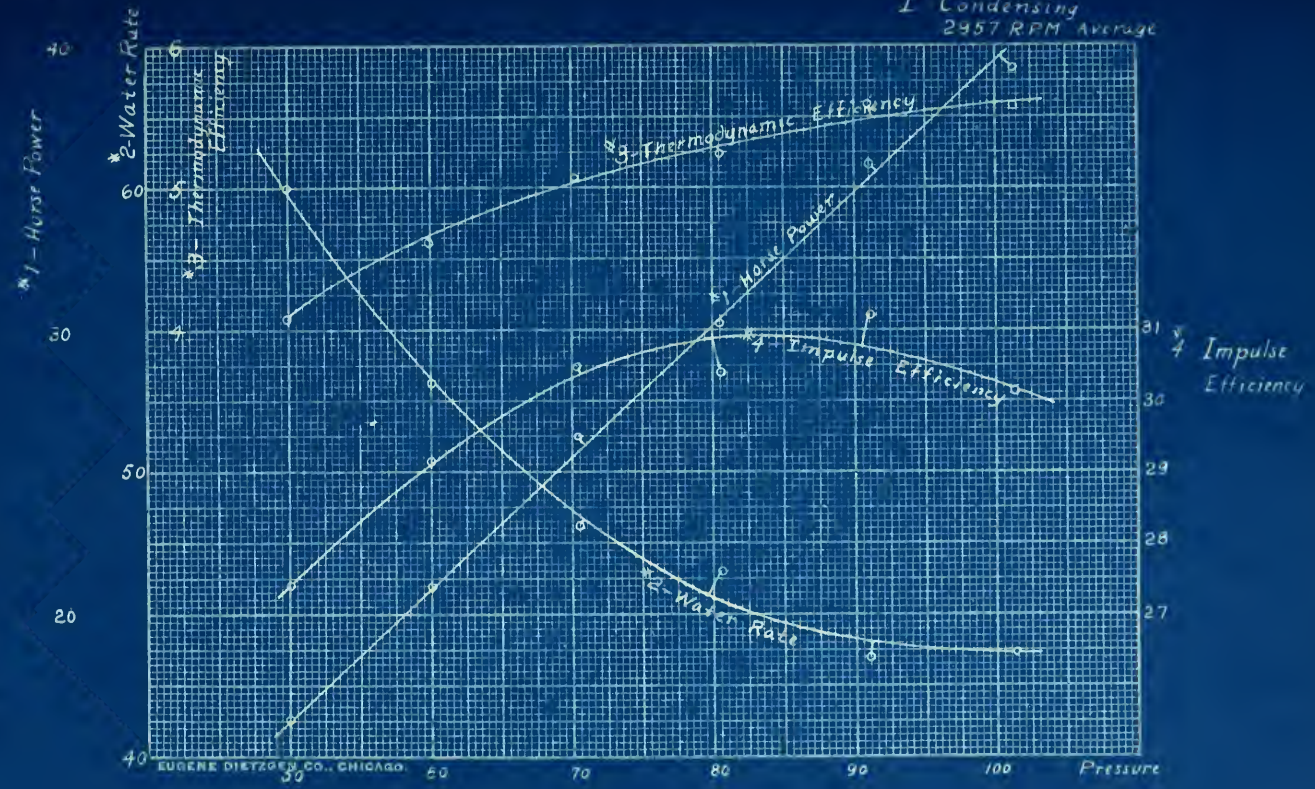
	CONDENSING				NON-CONDENSING			
St. Chest Press. No.	Actual Water Rate	Corr. Water Rate	Thermo. Eff.	Impulse Eff.	Actual Water Rate	Corr. Water Rate	Thermo. Eff.	Impulse Eff.
I. 1	62.2	59.9	4.08	27.4	116.6	112.3	2.25	20.6
2	55.1	53.1	4.61	29.15	90.9	87.8	2.88	24.1
3	50.0	48.0	5.07	30.5	78.4	75.7	3.34	25.9
4	48.4	46.5	5.24	30.4	71.5	68.8	3.66	27.1
5	45.4	43.5	5.59	31.2	67.7	65.0	3.87	27.0
6	45.6	43.6	5.57	30.1	61.5	59.1	4.26	28.3
II. 1	63.6	61.3	3.99	26.75	106.0	102.2	2.47	22.7
2	54.8	52.8	4.63	29.3	85.6	82.7	3.06	25.5
3	51.9	49.8	4.89	29.35	75.5	72.9	3.47	26.9
4	48.4	46.5	5.25	30.45	69.4	66.8	3.77	27.9
5	46.8	44.8	5.42	30.25	65.0	62.4	4.03	28.1
6	45.6	43.6	5.57	30.1	59.2	56.8	4.43	29.45
III. 1	59.6	57.4	4.26	28.6	96.6	93.1	2.72	24.9
2	52.5	50.6	4.84	30.5	81.2	78.4	3.23	26.9
3	49.4	47.4	5.14	30.9	66.9	64.6	3.91	30.4
4	49.2	47.2	5.16	29.9	67.4	64.8	3.89	28.7
5	46.2	44.3	5.49	30.7	61.4	59.0	4.27	29.7
6	45.5	43.5	5.58	30.1	59.7	57.4	4.38	29.2
IV. 1	64.3	61.9	3.95	26.5	97.2	93.6	2.7	24.75
2	55.0	53.0	4.62	29.1	82.9	80.0	3.16	26.35
3	50.1	48.1	5.07	30.5	76.8	74.2	3.41	26.5
4	50.0	48.0	5.08	29.45	70.75	68.1	3.70	27.3
5	47.5	45.5	5.34	29.8	66.7	64.1	3.93	27.4
6	47.7	45.6	5.32	28.8	62.1	59.6	4.22	28.1
V. 1	63.3	61.0	4.02	26.9	96.6	93.1	2.72	24.9
2	56.9	54.8	4.46	28.2	79.5	76.8	3.29	27.5
3	51.5	49.5	4.93	29.6	74.7	72.2	3.51	27.2
4	48.2	46.25	5.27	30.55	68.8	66.2	3.81	28.1
5	47.5	45.5	5.34	29.8	62.8	60.4	4.17	29.1
6	48.7	46.6	5.21	28.15	61.3	58.9	4.28	28.5
VI. 1	60.8	58.6	4.18	28.0	92.7	89.3	2.83	26.0
2	54.4	52.4	4.66	29.5	80.6	77.8	3.25	27.1
3	50.9	48.9	4.98	29.9	73.8	71.3	3.51	27.6
4	49.0	47.0	5.18	30.0	66.5	64.0	3.94	29.1
5	48.1	46.1	5.28	29.5	67.7	65.0	3.87	27.0
6	47.9	45.8	5.30	28.6	61.0	58.6	4.29	28.6
VII. 1	63.3	61.0	4.02	26.9	102.1	98.5	2.57	23.5
2	59.5	57.3	4.27	27.0	96.5	93.2	2.71	22.65
3	54.0	51.8	4.70	28.2	75.9	73.4	3.45	26.7
4	51.2	49.1	4.96	28.75	71.8	69.1	3.65	26.9
5	49.4	47.3	5.14	28.7	65.8	63.3	3.98	27.7
6	52.1	49.8	4.88	26.3	67.1	64.4	3.91	26.0

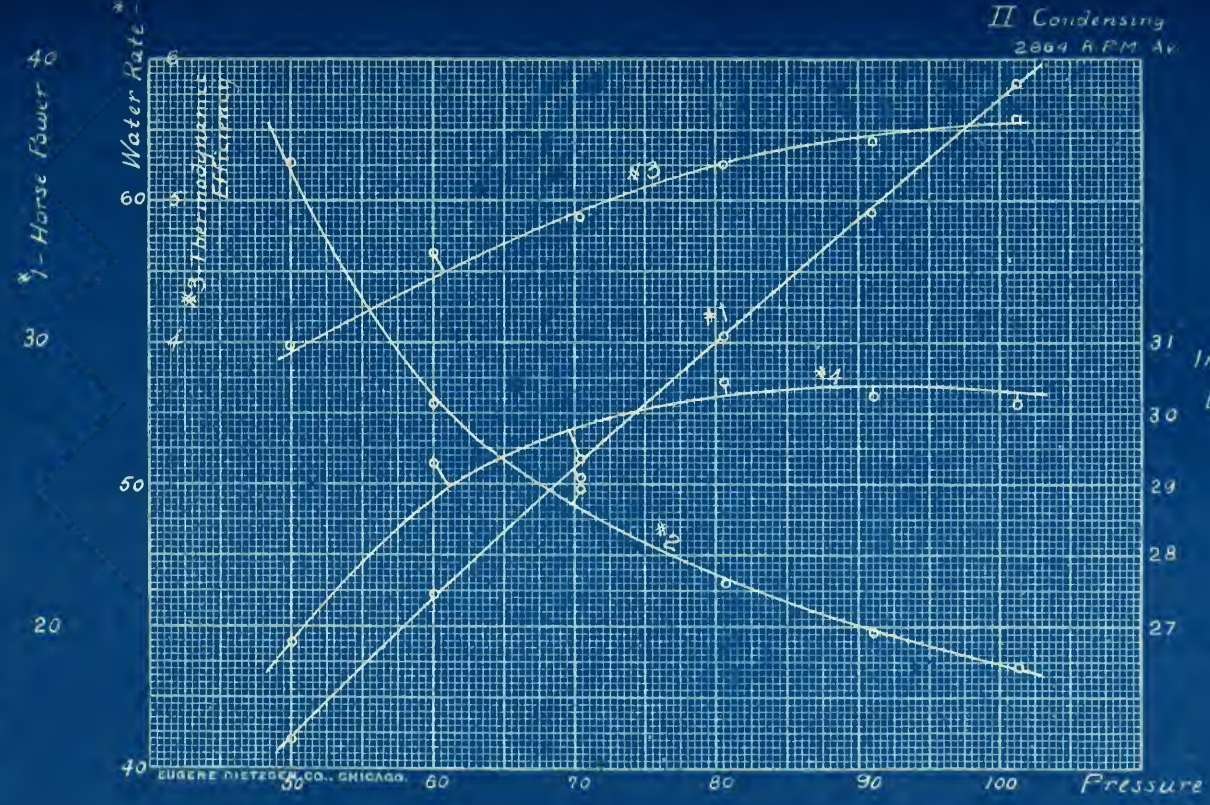
Test #1. DATA ON PUMP TESTS.

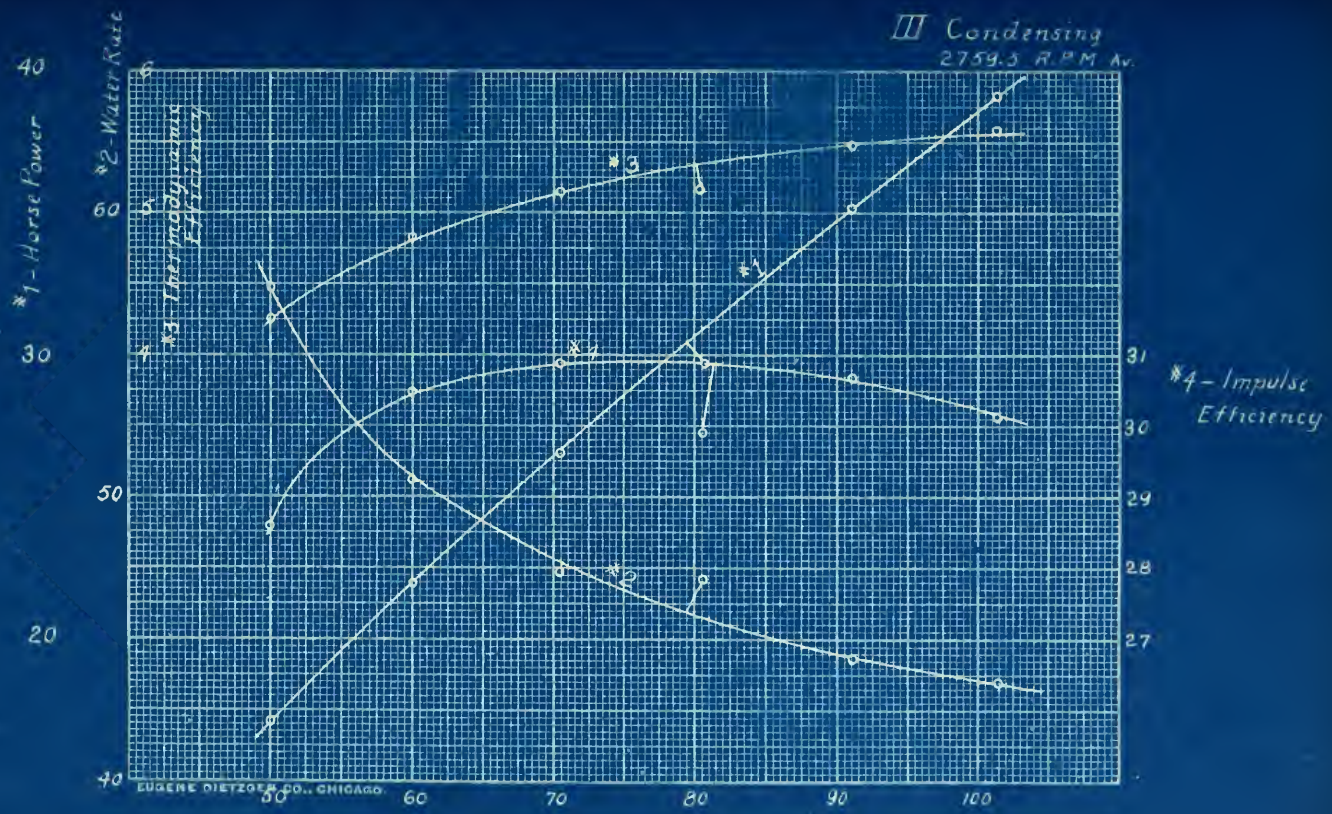
R.P.M.	2370	2365	2360	2365	2365	2378	2380	2387	2395
St. Chest P.	79.5	84.7	86	86.7	80.8	77.5	75.5	74.4	75.5
Vacuum "Hg	15.7	15.1	15.2	15.1	15.1	15.1	15.4	15.2	15.1
Discharge P	1507	141.3	119	106.5	93	74.5	57	46.8	35.6
Suction "Hg	13.7	17.2	21.7	22.4	21.4	21.8	21.9	22.3	22.3
" #/□"	6.73	8.45	10.68	11.02	10.53	10.72	10.78	10.97	10.97
Venturi Up St	1.2	3.7	7.8	8.3	8.0	8.8	9.3	9.3	10.0
" Th. "Hg	13.5	17.8	17.3	17.0	16.5	16.2	16.0	16.0	14.8
" " #/□"	6.63	8.75	8.5	8.35	8.11	7.96	7.86	7.86	7.27
Total Lift #/□"	157.43	149.75	129.68	119.52	103.53	85.22	67.78	57.77	46.47
Meter Head #/□"	7.83	12.45	16.3	16.65	16.11	16.76	17.16	17.16	17.27
Gallons./min.	126	162.5	186.5	189	185.5	189.5	191.5	191.5	192.5
Pounds "	1050	1354	1554	1575	1545	1580	1594	1594	1604
H.P Input	28.1	30.5	31.1	31.4	28.8	27.25	26.3	26.25	26.25
H.P Output	11.57	14.19	14.09	13.18	11.2	9.43	7.59	6.45	5.21
Eff.	41.1	46.5	45.25	42.0	38.9	34.6	28.9	24.6	19.83

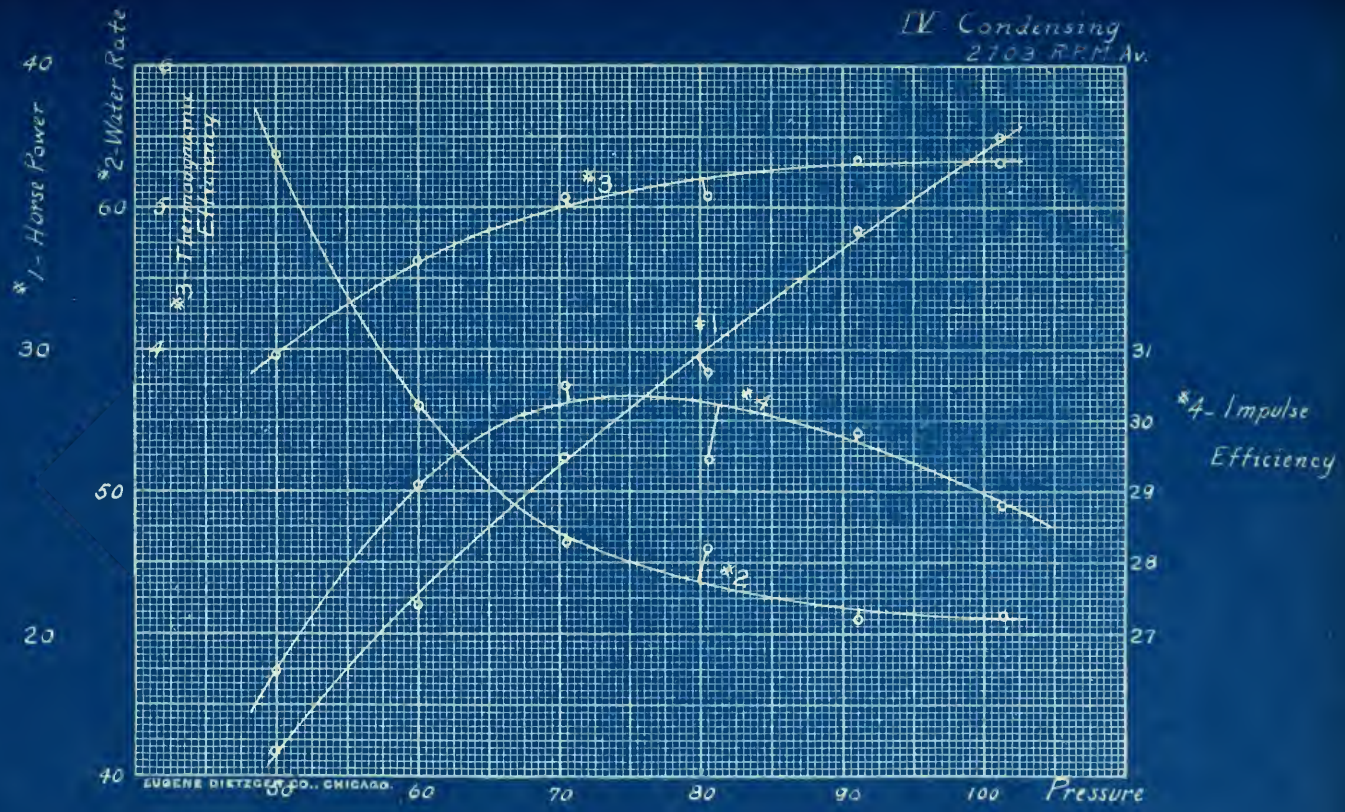
Test #2. R.P.M.	2472	2440	2472	2440	2455	2495	2480	2490	2500
St. Chest P.	91.5	91.5	91.3	87.5	85.6	84.7	81.5	81.5	79.5
Vacuum "Hg	15.1	15.4	15.4	15.1	15.1	16.1	15.1	15.1	15.1
Discharge P	155	129	113.5	100.3	90	72.5	59	44.5	34.5
Suction "Hg	18.7	23.4	23.9	23.8	24.1	24.2	24.2	24.2	24.2
" #/□"	9.19	11.5	11.76	11.71	11.85	11.9	11.9	11.9	11.9
Venturi Up St	2.8	6.9	7.7	7.8	8.3	8.5	8.9	9.8	11.0
" Th. "Hg	19.2	20.1	19.8	19.7	19.0	18.8	18.5	17.2	16.0
" " #/□"	9.44	9.83	9.73	9.68	9.34	9.24	9.09	8.45	7.86
Total Lift #/□"	164.19	140.5	125.26	112.01	101.85	84.4	70.9	56.4	46.4
Meter Head #/□"	12.24	16.73	17.43	17.48	17.64	17.74	17.99	18.25	18.86
Gals./min.	161.0	189.5	193.0	193.4	194.5	195.0	196.3	198.0	201.0
Lbs. "	1341	1580	1608	1611	1620	1625	1634	1650	1674
H.P. Input	34.0	34.0	33.9	32.6	31.8	31.4	30.25	30.25	29.5
H.P. Output	15.4	15.53	14.09	12.62	11.65	9.6	8.1	6.51	5.44
Eff.	45.3	45.7	41.5	38.85	36.3	30.5	26.75	21.5	18.4

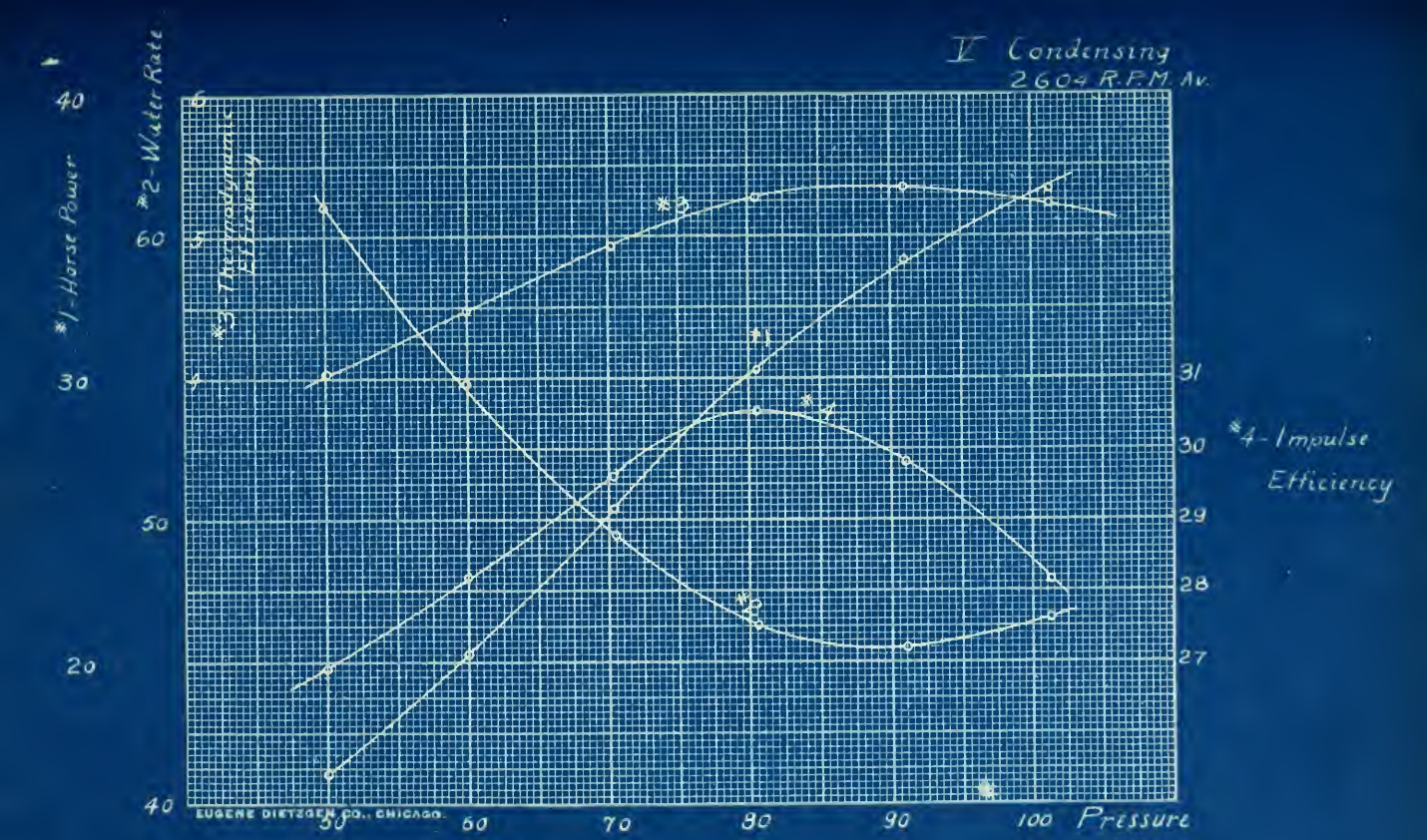
Test #3. R.P.M.	2560	2592	2600	2620	2625	2625	2635		
St. Chest P.	106.8	104.8	97.5	98.7	96.7	92.8	91.5		
Vacuum "Hg	15.1	15.1	15.1	14.6	14.9	15.1	15.4		
Discharge P.	155	129	113.5	93	72.5	57	42.8		
Suction "Hg.	22.9	24.2	24.2	23.9	23.9	23.9	24.2		
" #/□"	11.27	11.9	11.9	11.76	11.76	11.76	11.9		
Venturi Up St	14.1	14.5	15.3	12.2	12.5	13.0	15.5		
" Th. "Hg	19.3	19.85	19.0	19.4	18.8	18.4	16.5		
" " #/□"	9.48	9.75	9.34	9.54	9.24	9.04	7.62		
Total Lift #/□"	166.21	140.9	125.4	104.76	84.26	68.76	54.7		
Meter Head #/□"	23.58	24.25	24.64	21.74	21.74	22.04	23.12		
Gals./min.	225	228	230	215	216	217	222.5		
Lbs. "	1873	1900	1917	1800	1800	1808	1854		
H.P. Input	38.0	37.6	35.8	36.1	35.6	34.6	34.2		
H.P. Output	21.8	18.72	16.82	13.18	10.61	8.71	7.1		
Eff.	57.3	49.8	47.0	36.5	29.8	25.15	20.8		

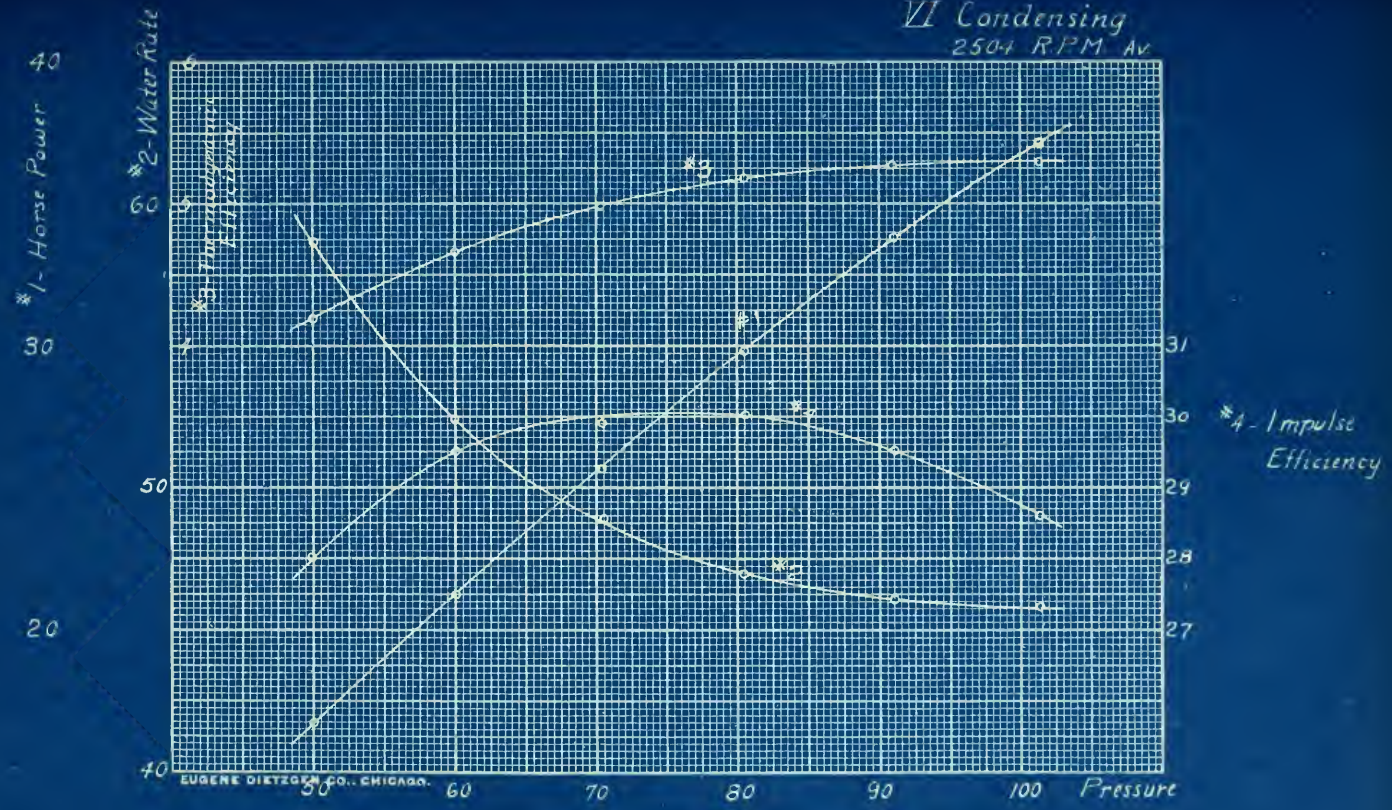

I Condensing
2957 RPM Average
*1 – Horse Power
*2 – Water Rate
*3 – Thermodynamic Efficiency
*4 – Impulse Efficiency
Pressure
EUGENE DIETZGEN CO., CHICAGO.

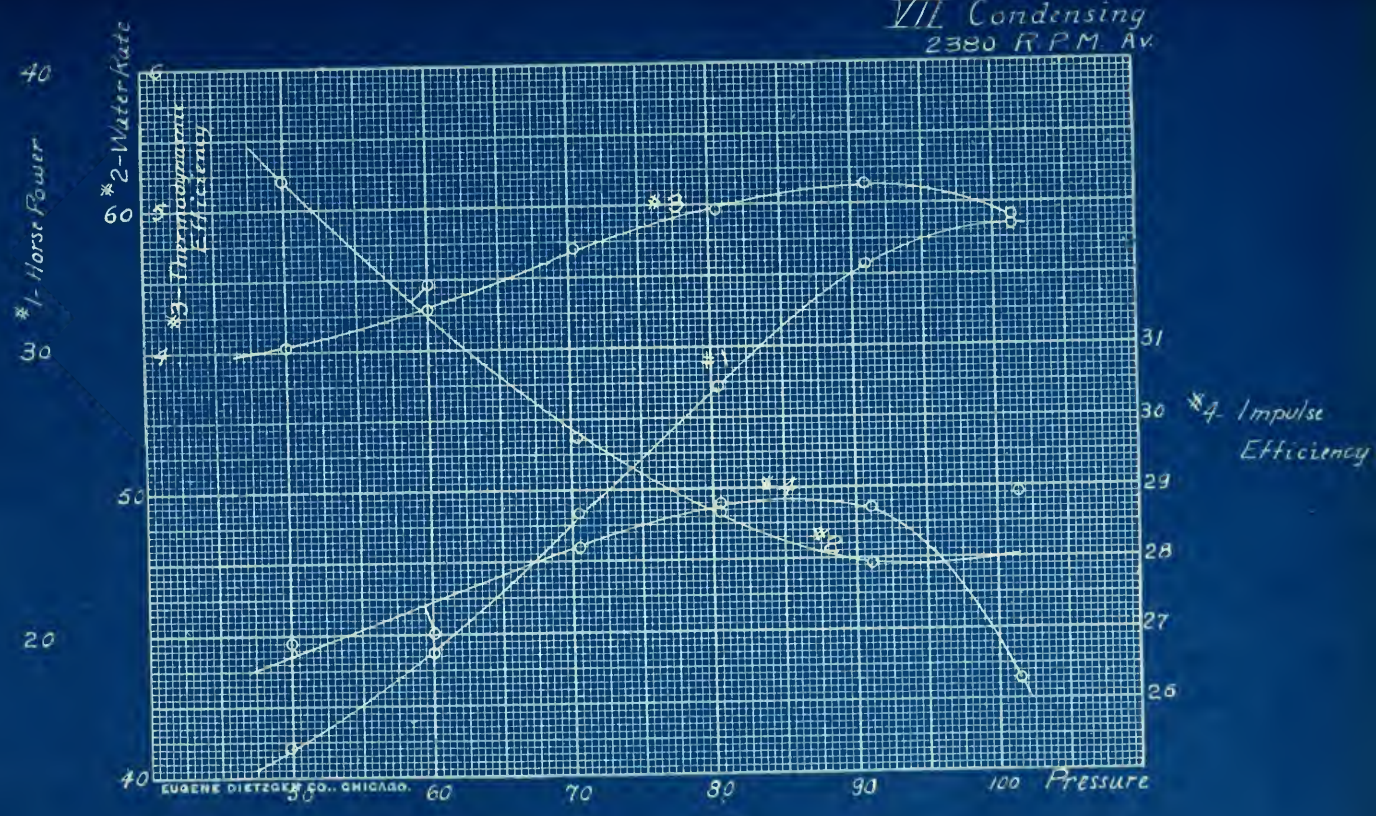

II Condensing
2864 R.P.M. Av.
#1 - Horse Power
#2 Water Rate
#3 Thermodynamic Efficiency
#4 Impulse Efficiency
Pressure
40
30
20
60
50
40
31
30
29
28
27
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

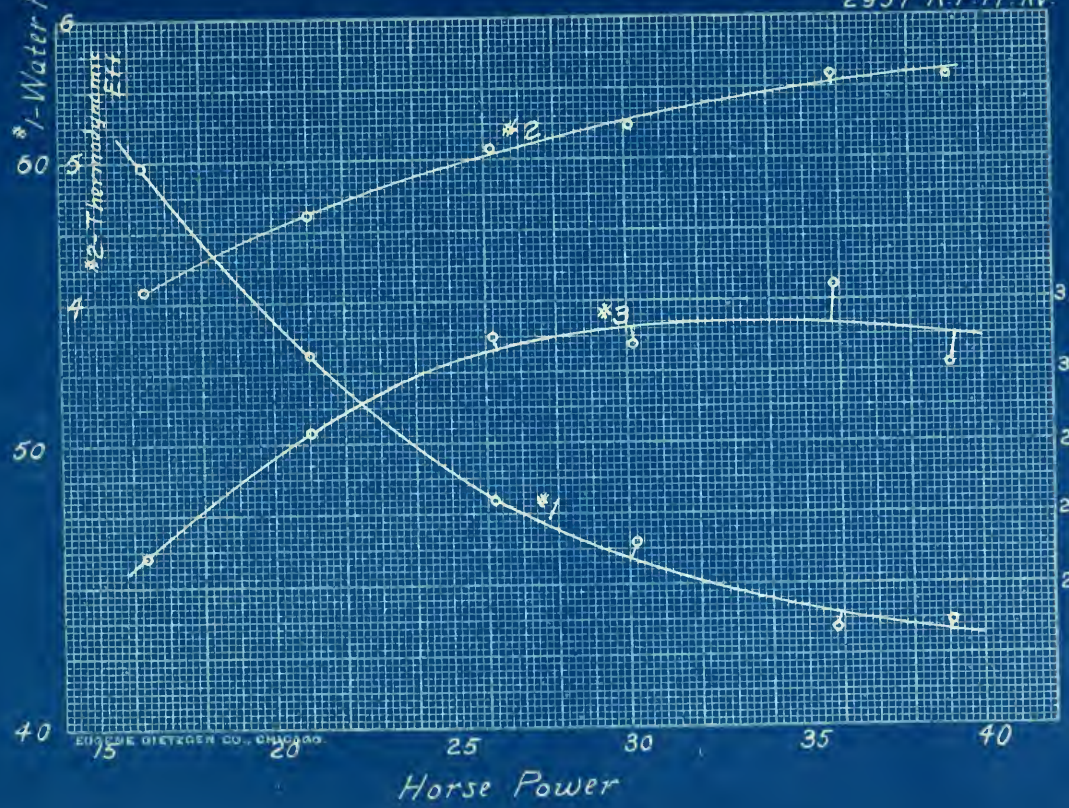

III Condensing
2759.3 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#3 Thermodynamic Efficiency
#4 - Impulse Efficiency
#1
#2
#3
#4
40
30
20
60
50
40
31
30
29
28
27
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO

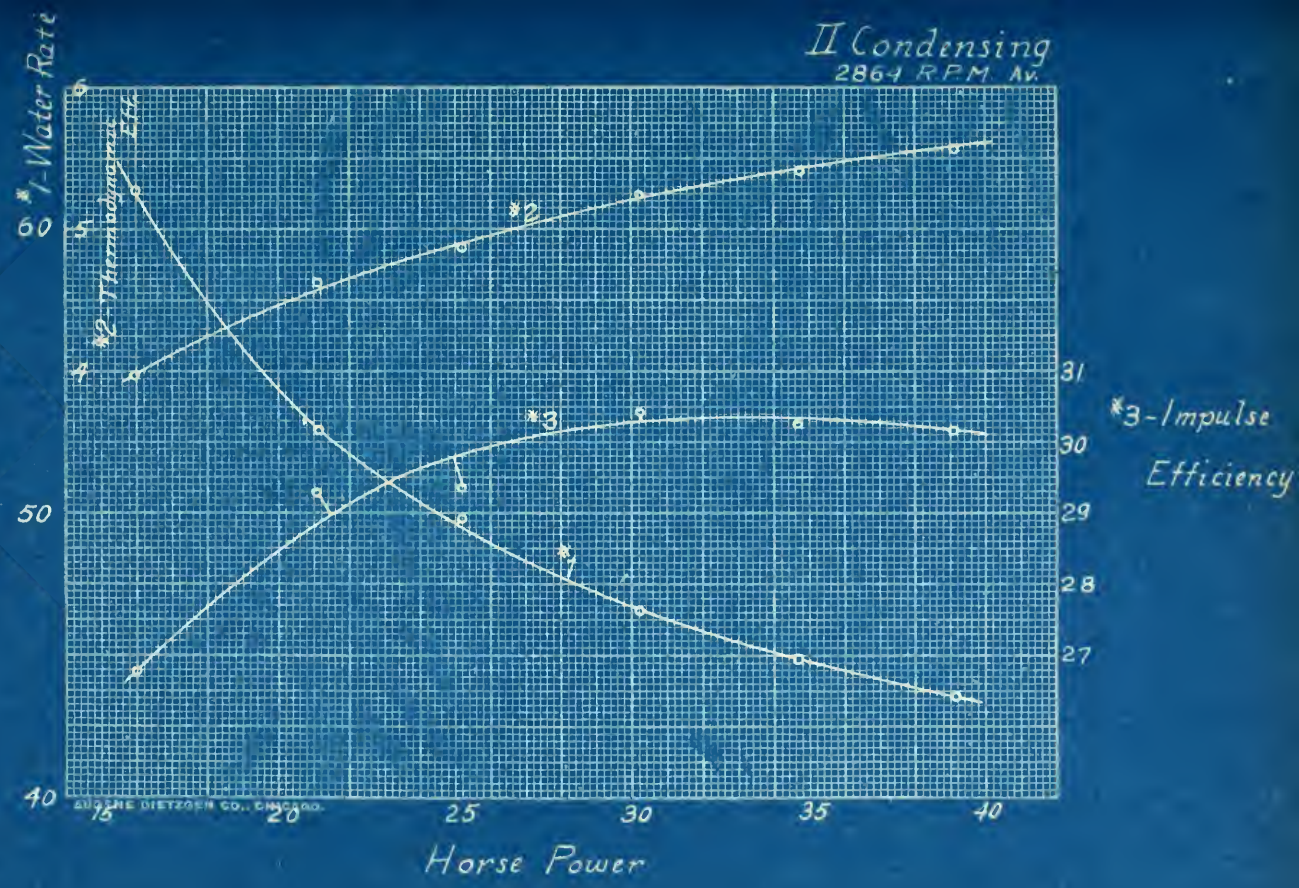

IV Condensing
2103 R.P.M. Av.
*1- Horse Power
*2- Water Rate
*3 Thermodynamic Efficiency
*4- Impulse Efficiency
40
30
20
50
40
31
30
29
28
27
50
60
70
80
90
100
Pressure
*1
*2
*3
*4
EUGENE DIETZGEN CO., CHICAGO.

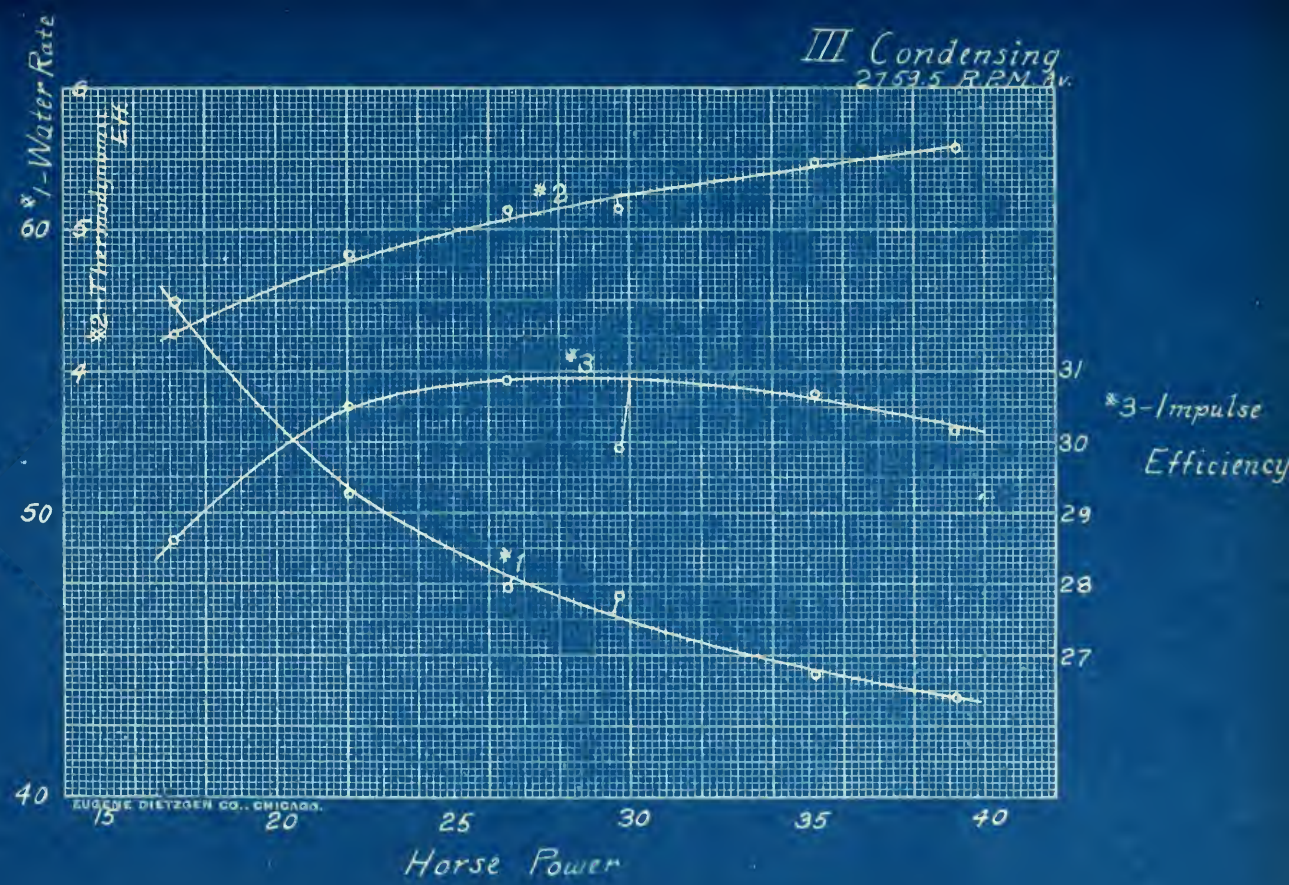

V Condensing
2604 R.P.M. Av.
*1-Horse Power
*2-Water Rate
*3-Thermodynamic Efficiency
*4-Impulse Efficiency
Pressure
40
30
20
60
50
40
31
30
29
28
27
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

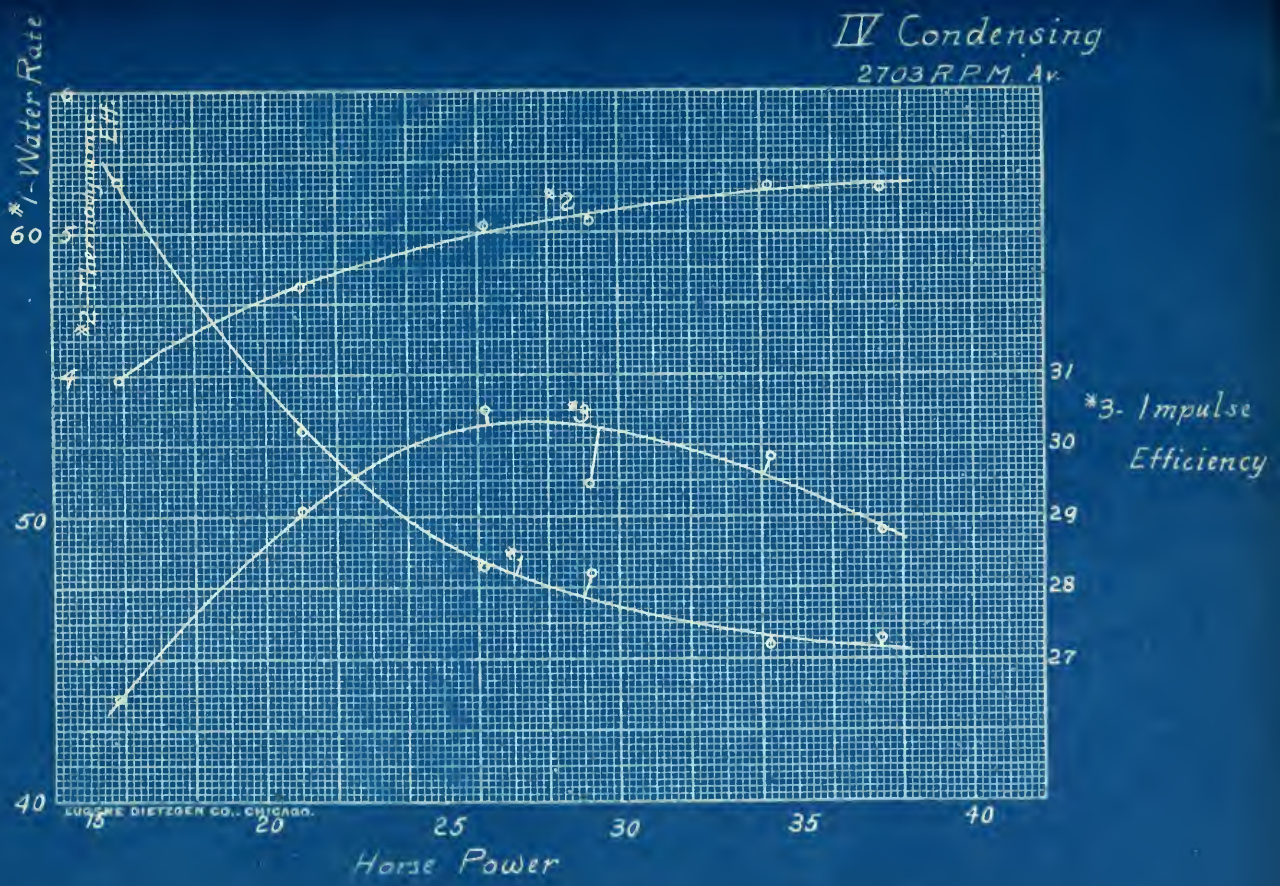

VI Condensing
250-1 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#3 - Thermodynamic Efficiency
#4 - Impulse Efficiency
40
30
20
60
50
40
31
30
29
28
27
50
60
70
80
90
100
Pressure
EUGENE DIETZGEN CO., CHICAGO.

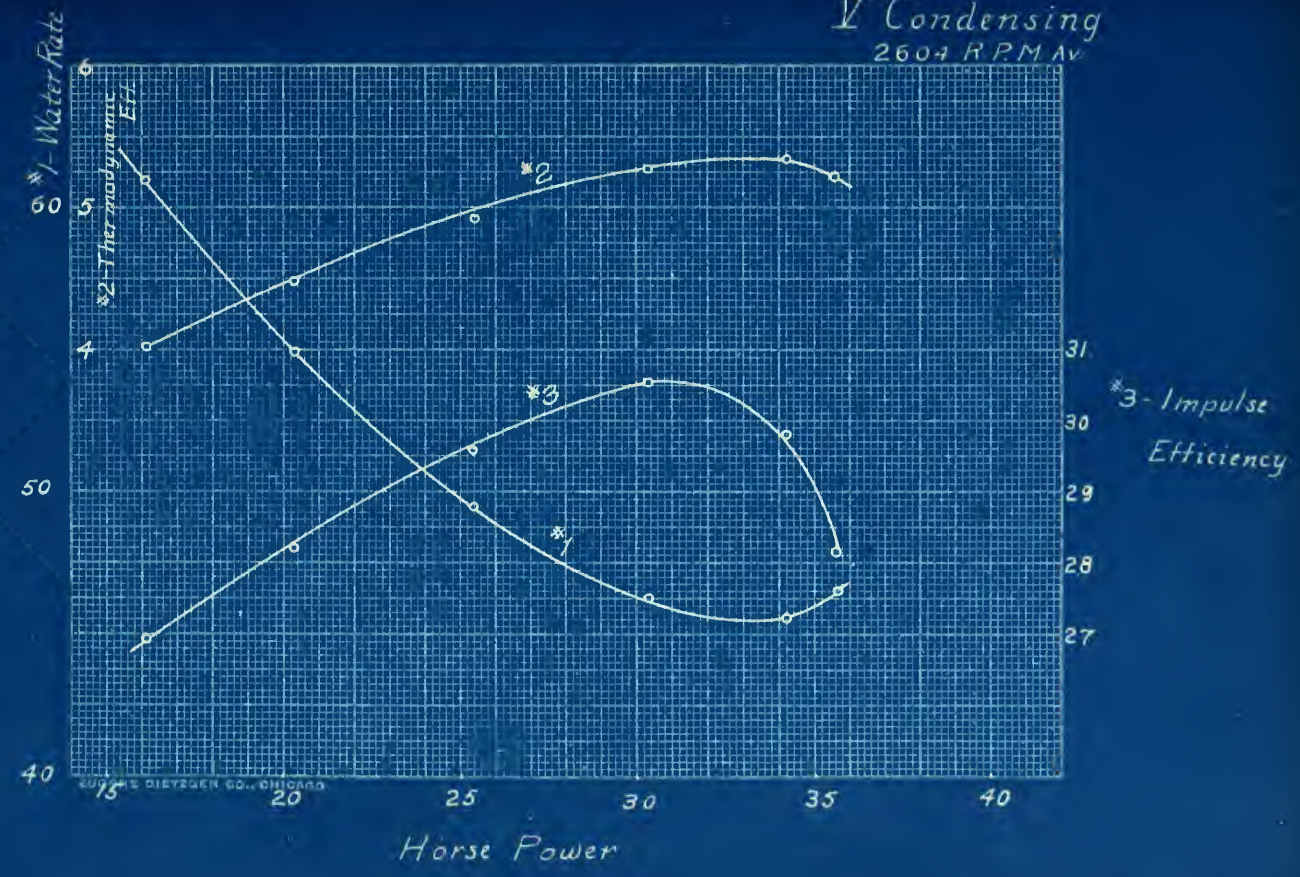

VII Condensing
2380 R.P.M. Av.
*1- Horse Power
*2- Water Rate
*3- Thermodynamic Efficiency
*4- Impulse Efficiency
Pressure
40
30
20
60
50
40
31
30
29
28
27
26
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

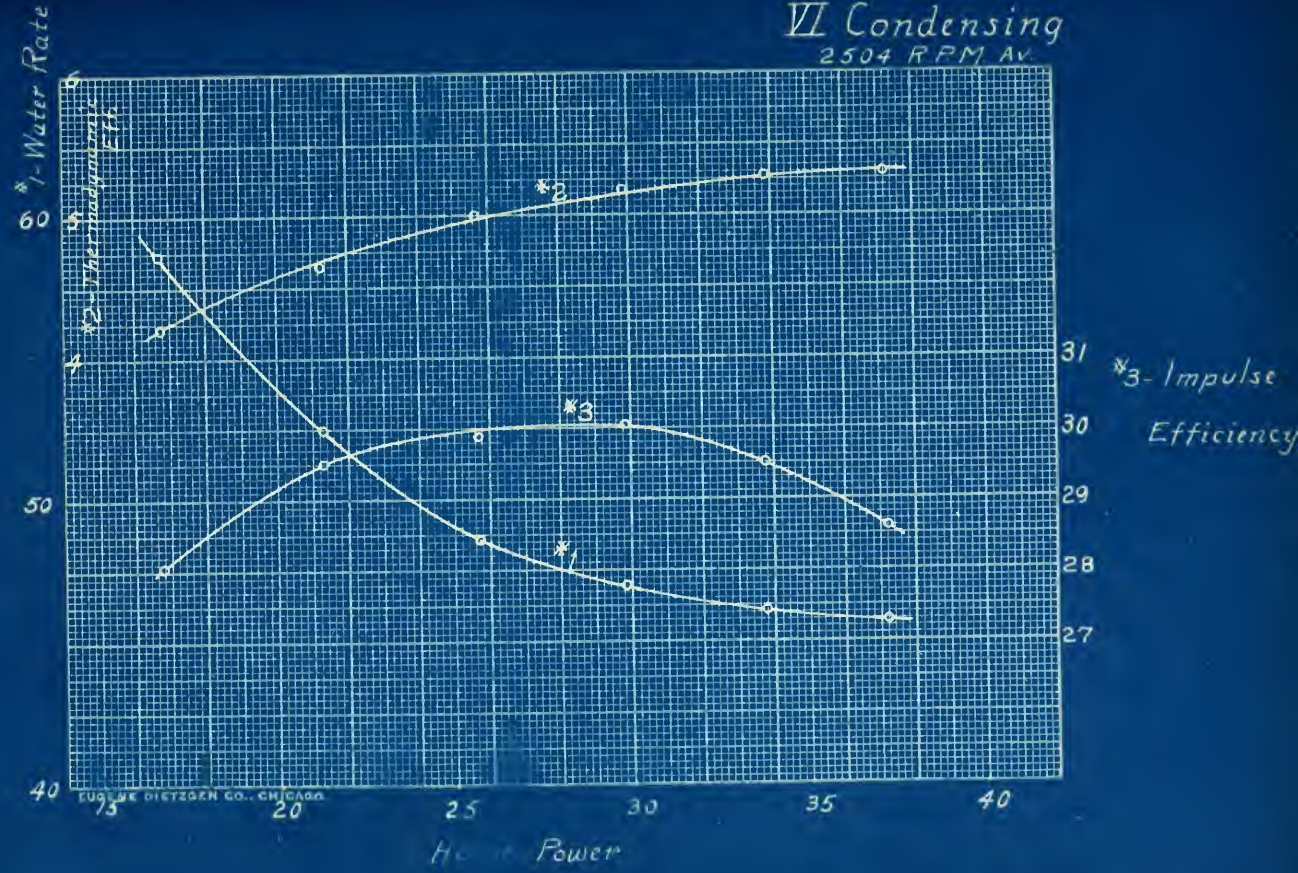

I Condensing
2957 R.P.M. Av.
*1-Water Rate
*2-Thermodynamic Eff.
*3-Impulse Efficiency
Horse Power
*1
*2
*3
6
5
4
60
50
40
31
30
29
28
27
15
20
25
30
35
40
EUGENE DIETZGEN CO., CHICAGO.


II Condensing
2864 R.P.M. Av.
*1-Water Rate
*2-Thermodynamic Eff.
*2
*3
*1
*3-Impulse Efficiency
60
50
40
31
30
29
28
27
15
20
25
30
35
40
Horse Power
EUGENE DIETZGEN CO., CHICAGO.

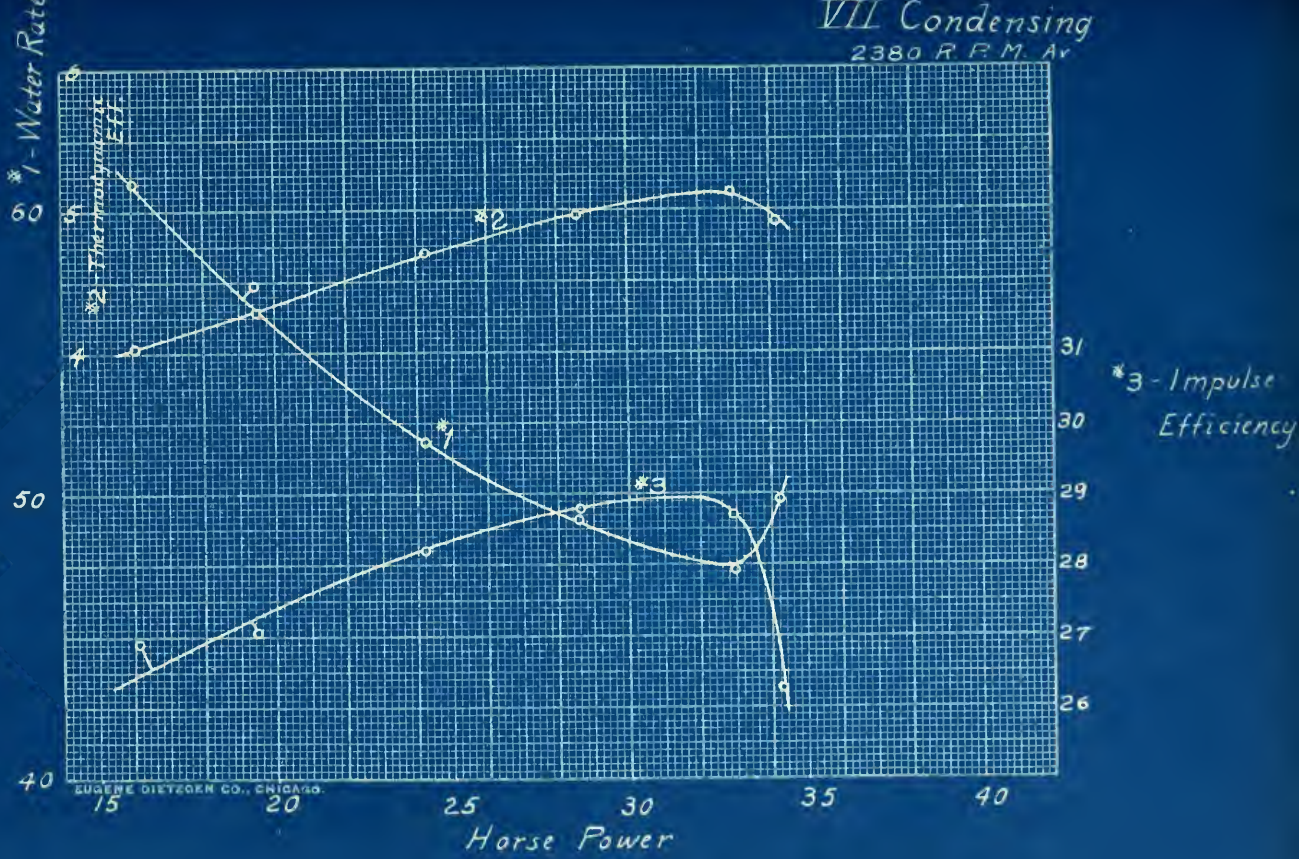

III Condensing
2753.5 R.P.M. Av.
#1-Water Rate
#2 Thermodynamic Eff.
#3-Impulse Efficiency
#1
#2
#3
60
50
40
31
30
29
28
27
15
20
25
30
35
40
Horse Power
EUGENE DIETZGEN CO., CHICAGO.

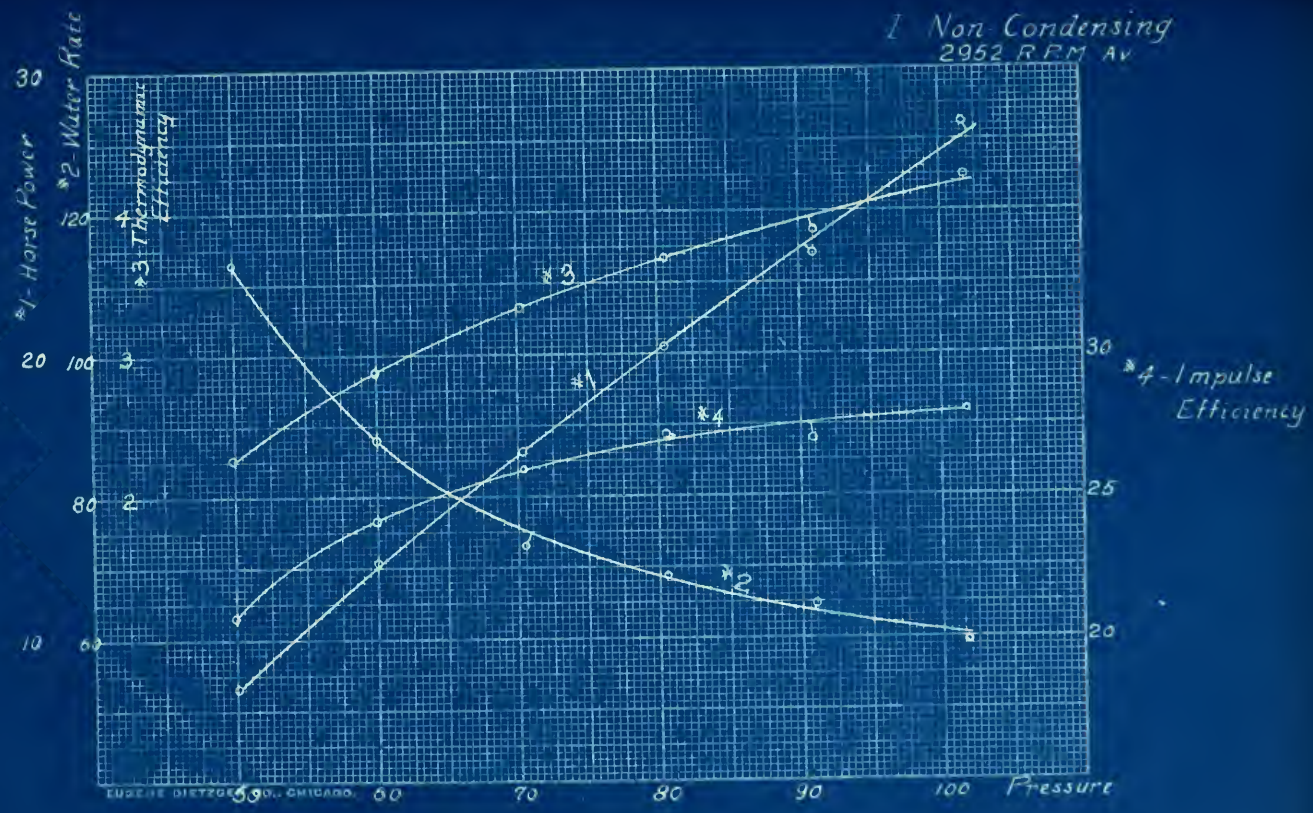

IV Condensing
2703 R.P.M. Av.
*1- Water Rate
*2- Thermodynamic Eff.
*3- Impulse Efficiency
60
50
40
31
30
29
28
27
15
20
25
30
35
40
Horse Power
LUDLOW-DIETZGEN CO., CHICAGO.

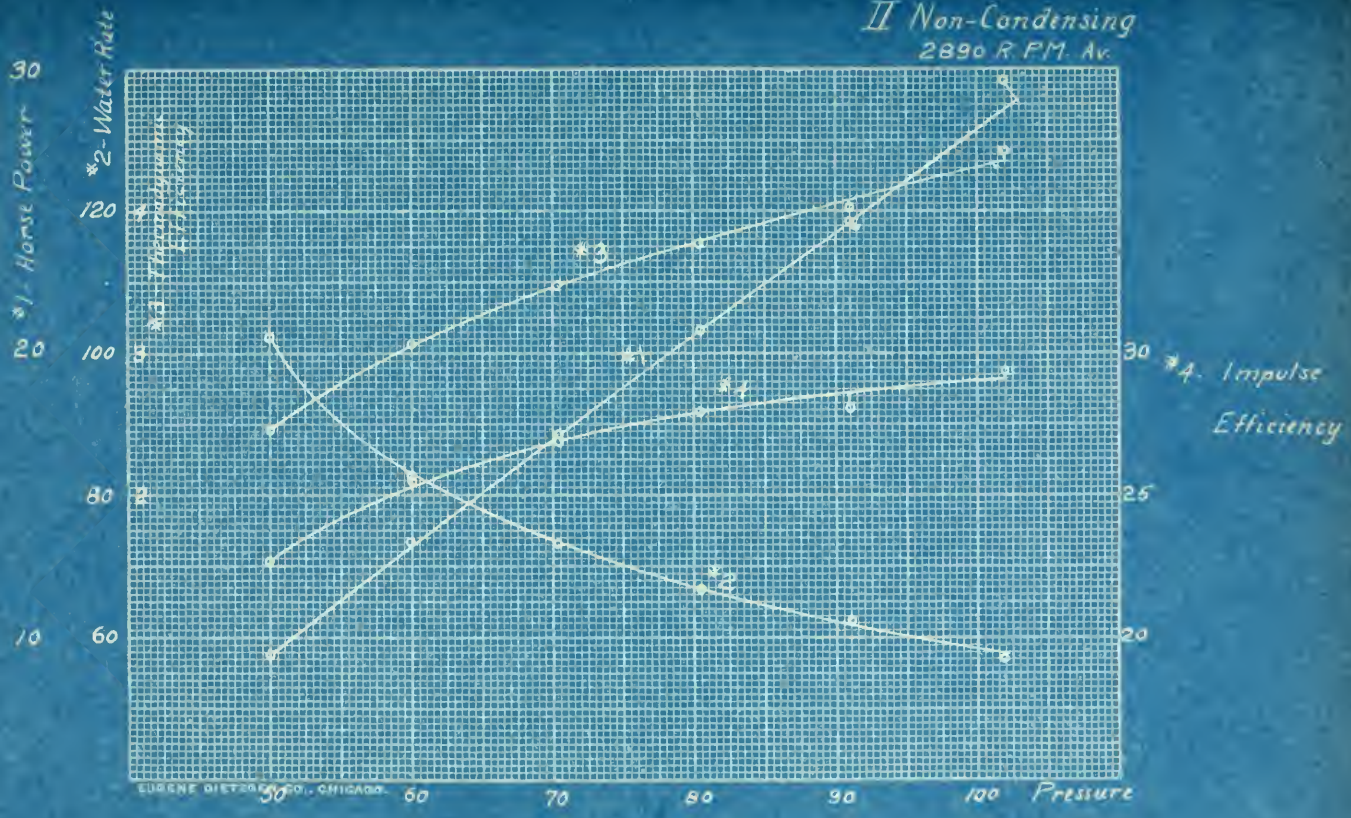

V Condensing
2604 R P M Av
#1 - Water Rate
#2 - Thermodynamic Eff.
#3 - Impulse Efficiency
#1
#2
#3
60
50
40
6
5
4
31
30
29
28
27
15
20
25
30
35
40
Horse Power
EUGENE DIETZGEN CO., CHICAGO

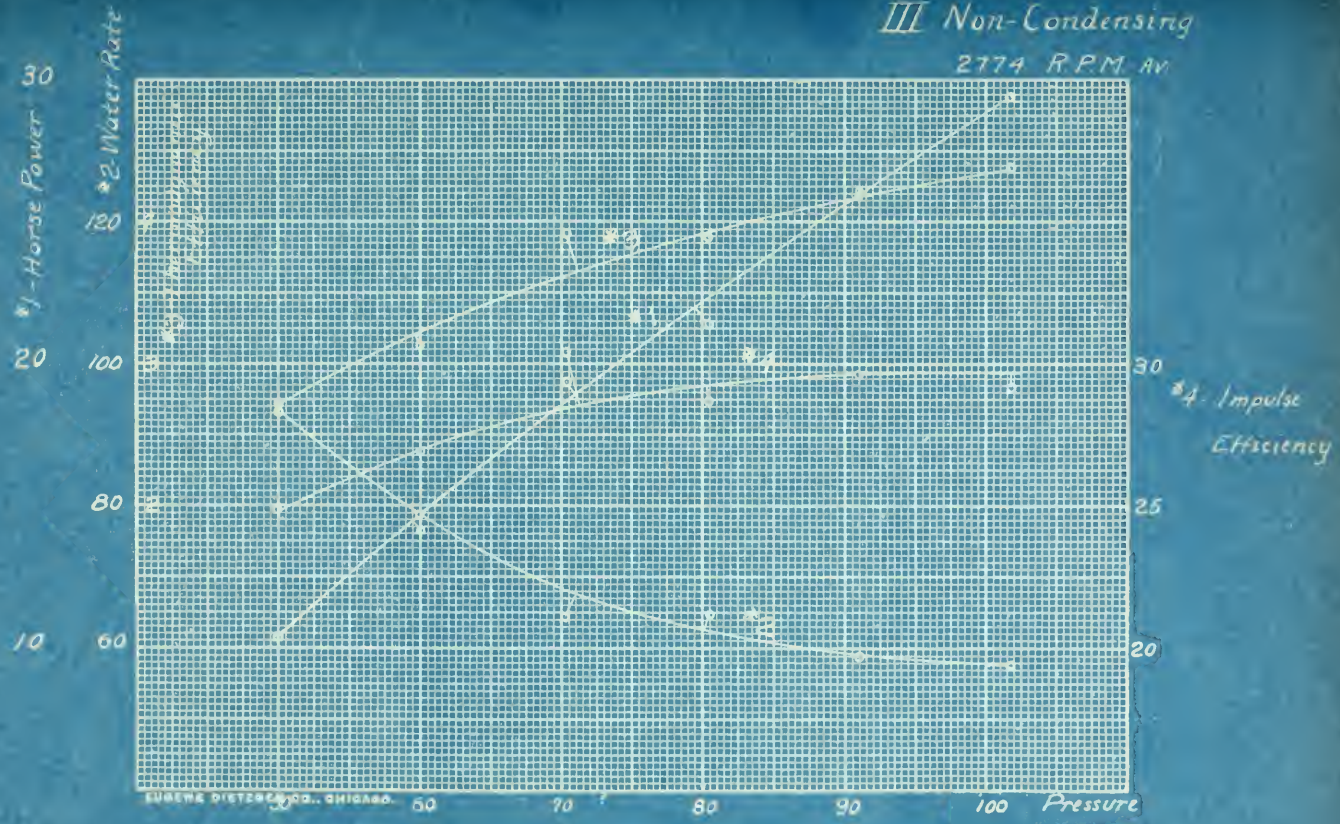

VI Condensing
2504 R.P.M. Av.
*1- Water Rate
*2- Thermodynamic Eff.
*3- Impulse Efficiency
60
50
40
31
30
29
28
27
15
20
25
30
35
40
*1
*2
*3
EUGENE DIETZGEN CO., CHICAGO

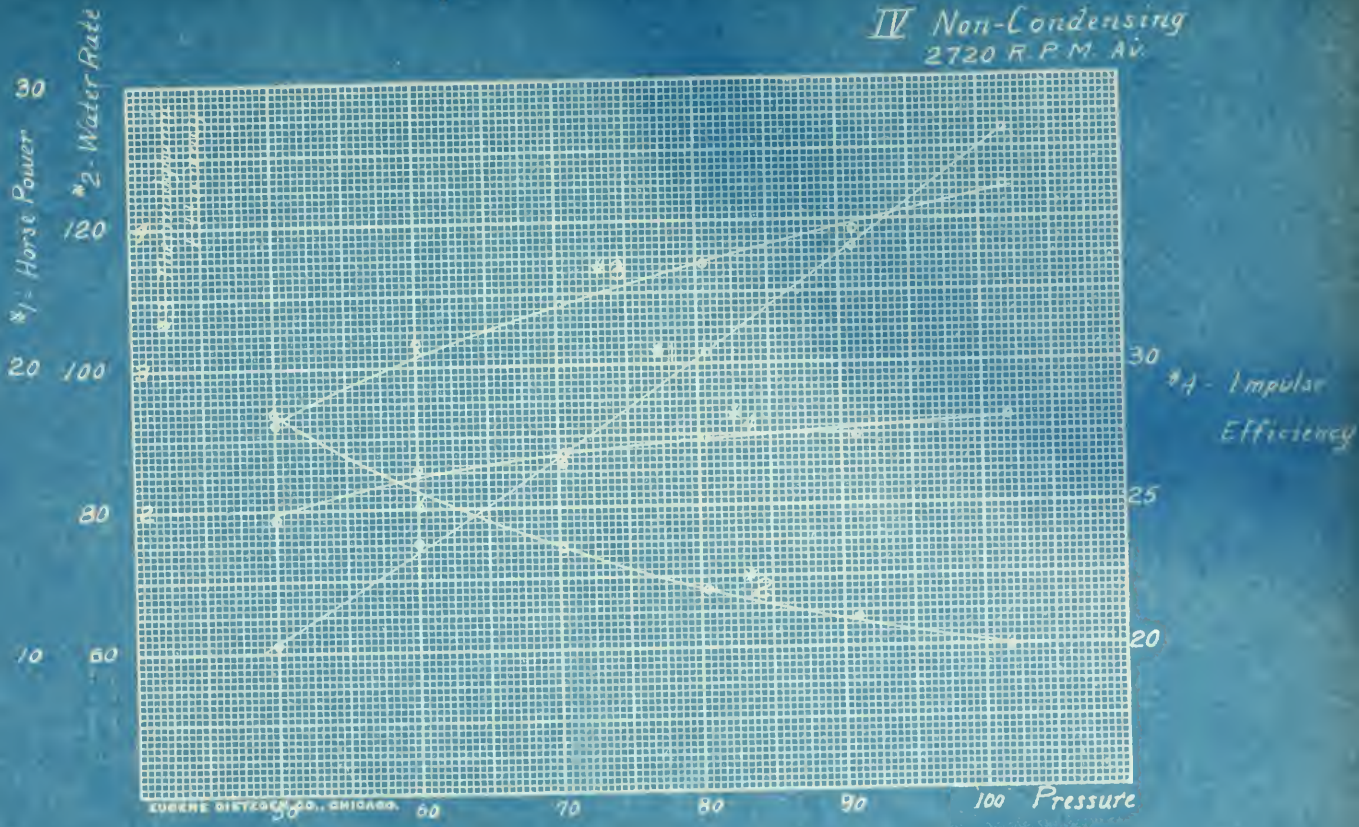
H.P. Power

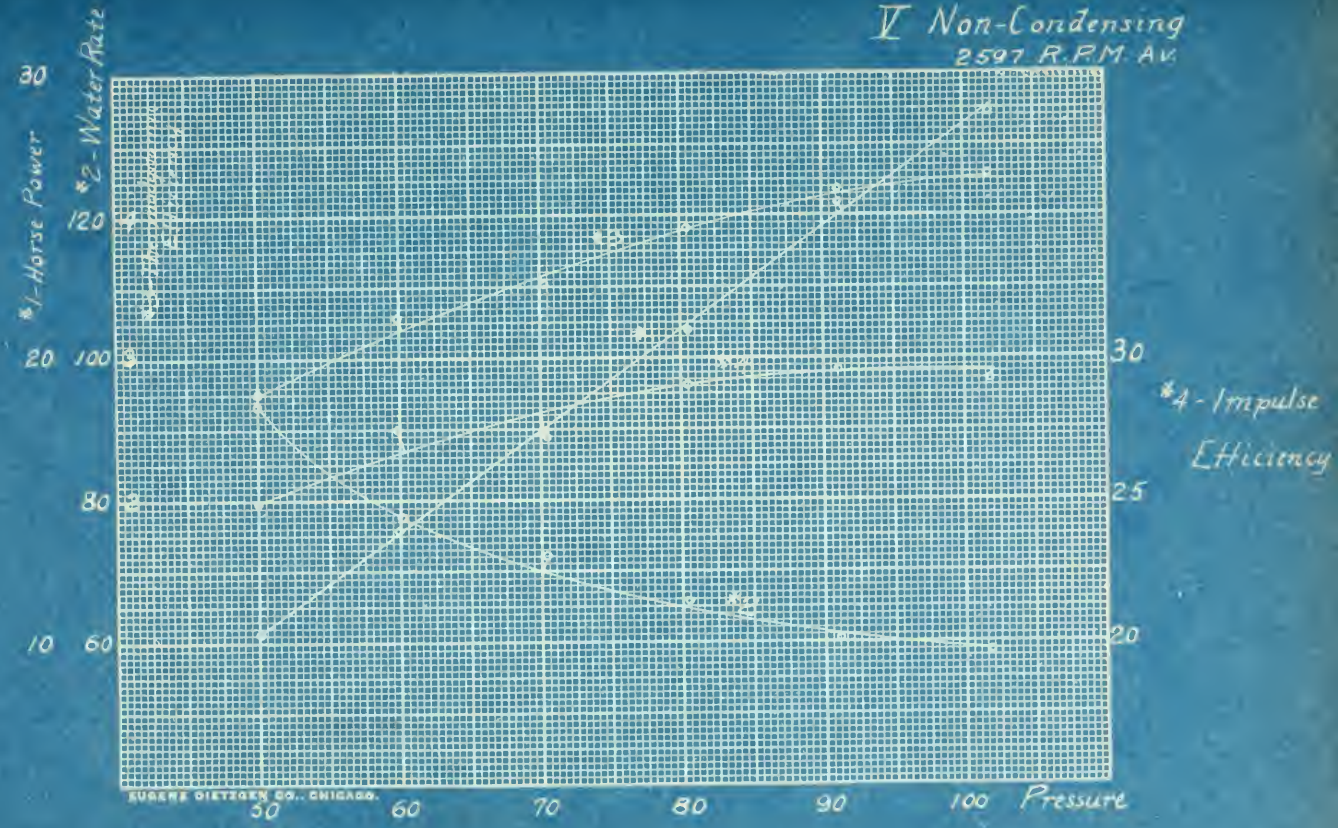

VII Condensing
2380 R.P.M. Av
*1 - Water Rate
*2 - Thermodynamic Eff.
*3 - Impulse Efficiency
60
50
40
31
30
29
28
27
26
15
20
25
30
35
40
Horse Power
*1
*2
*3
EUGENE DIETZGEN CO., CHICAGO.

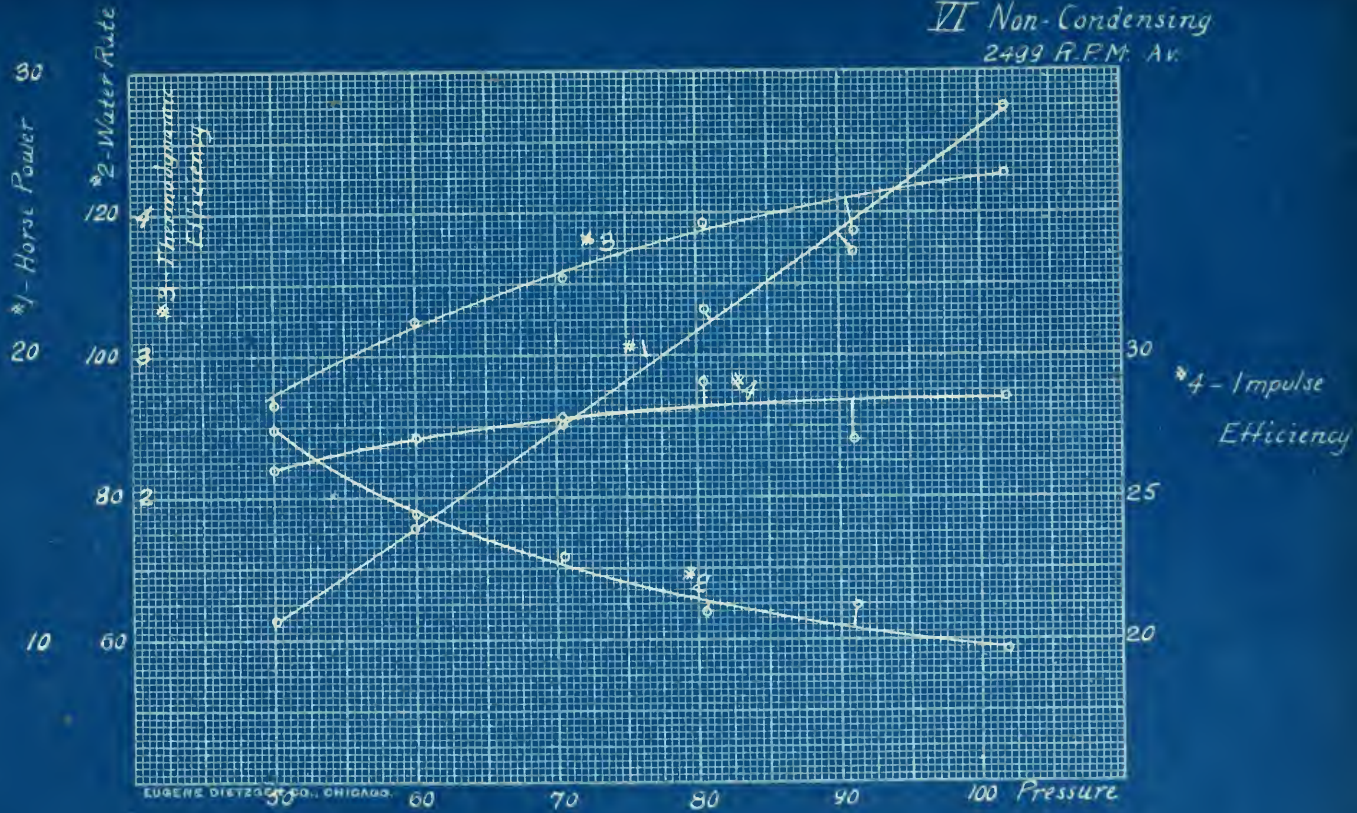

1 Non Condensing
2952 R.P.M. Av
#1 - Horse Power
#2 - Water Rate
#3 Thermodynamic Efficiency
#4 - Impulse Efficiency
Pressure
30
120
20
100
80
10
60
50
70
80
90
100
25
#1
#2
#3
#4
EUGENE DIETZGEN CO., CHICAGO.

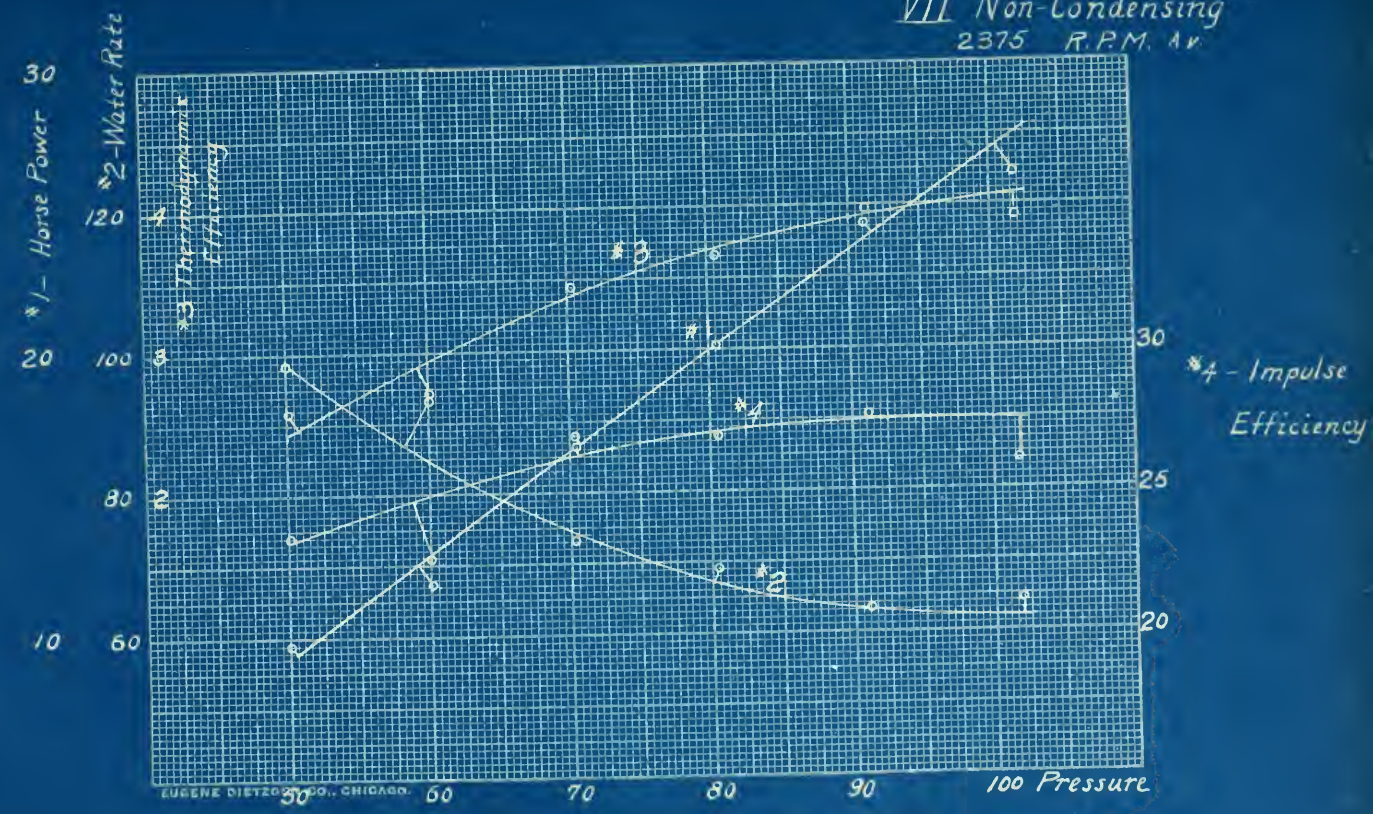

II Non-Condensing
2890 R.P.M. Av.
*1. Horse Power
*2. Water Rate
*3. Steam Consumption
*4. Impulse Efficiency
Pressure
30
20
10
120
100
80
60
30
25
20
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

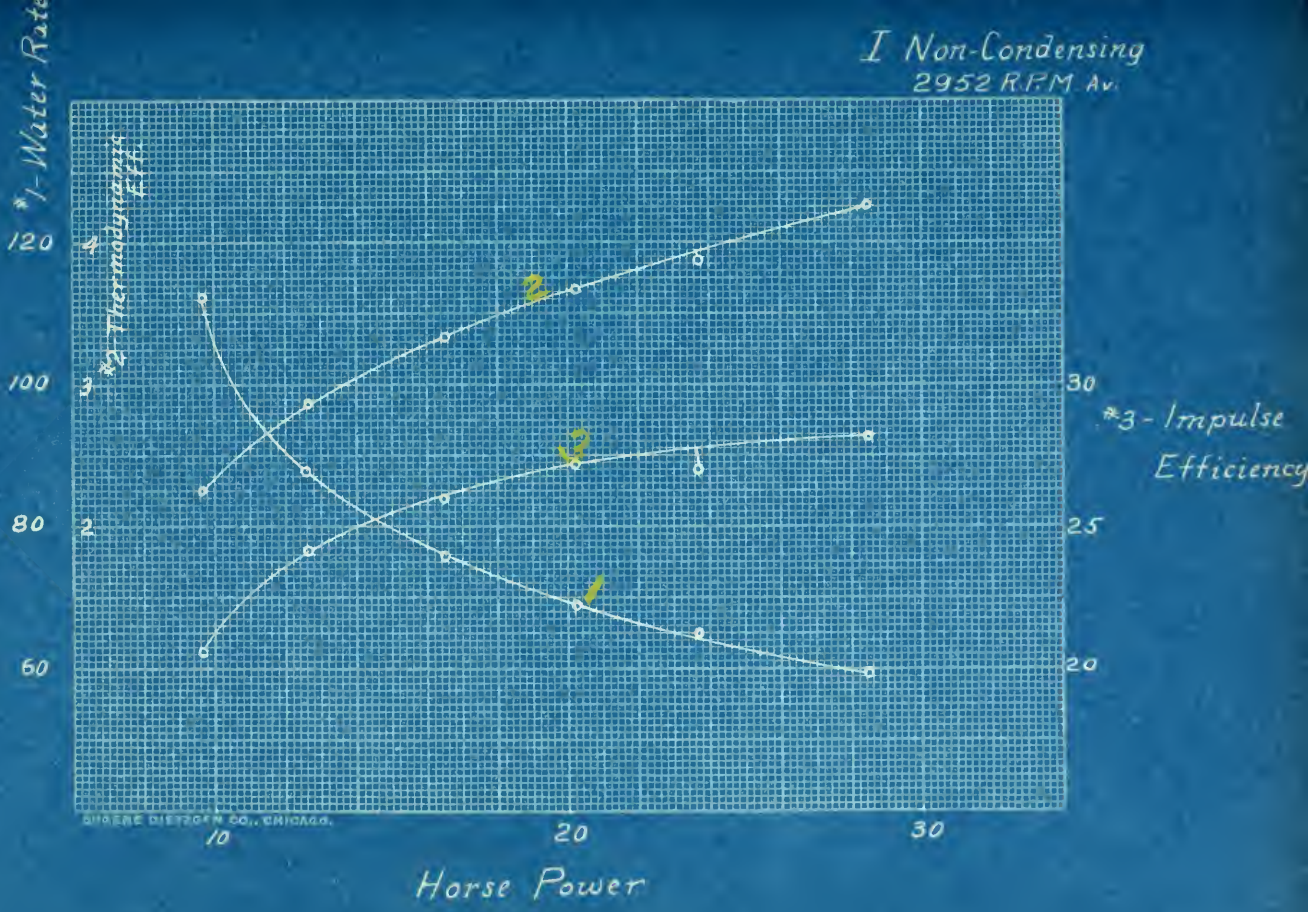

III Non-Condensing
2774 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#4 - Impulse Efficiency
Pressure
30
20
120
100
80
60
25
20
50
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

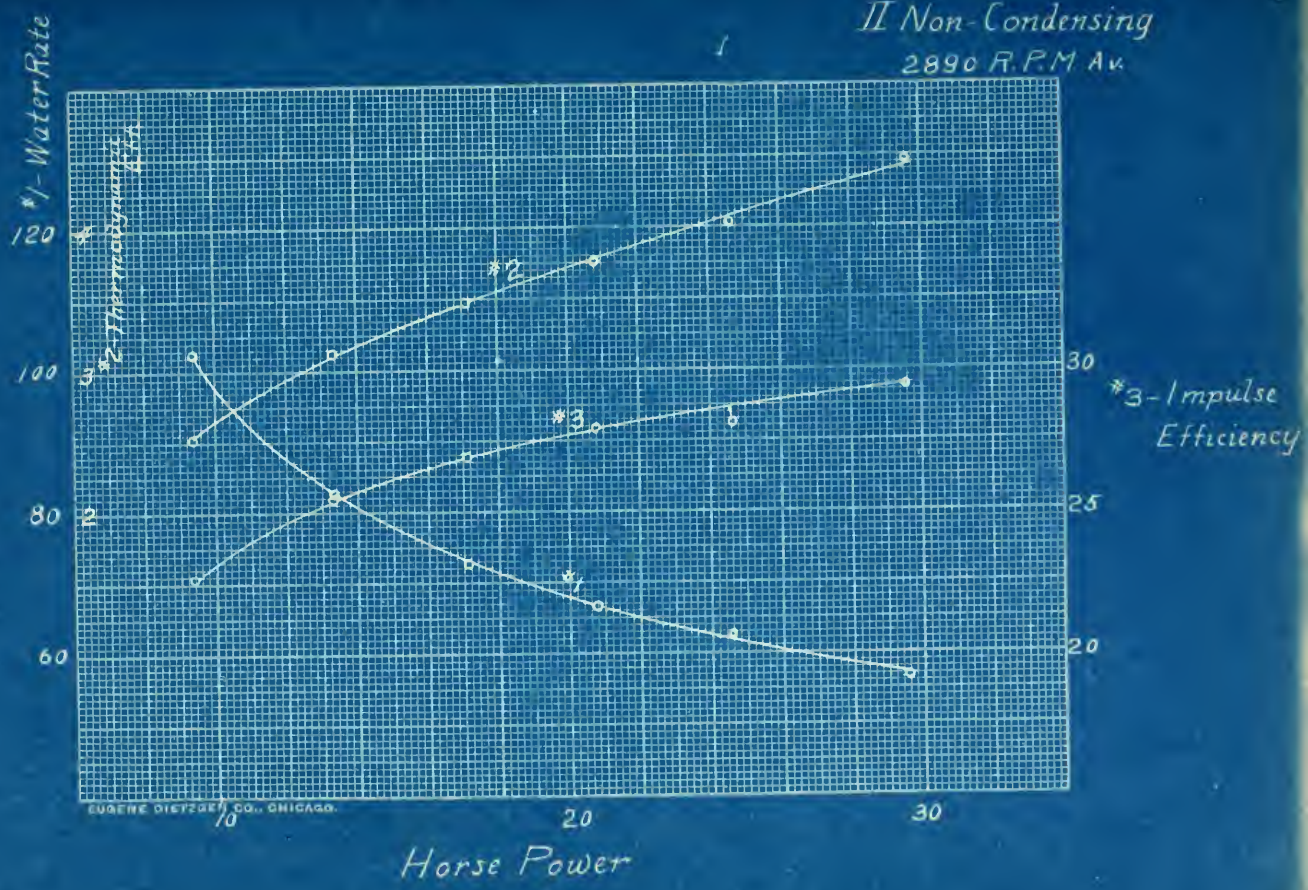

IV Non-Condensing
2720 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#4 - Impulse Effictency
30
120
20
100
80
10
60
30
25
20
50
60
70
80
90
100
Pressure
EUGENE DIETZGEN CO., CHICAGO.

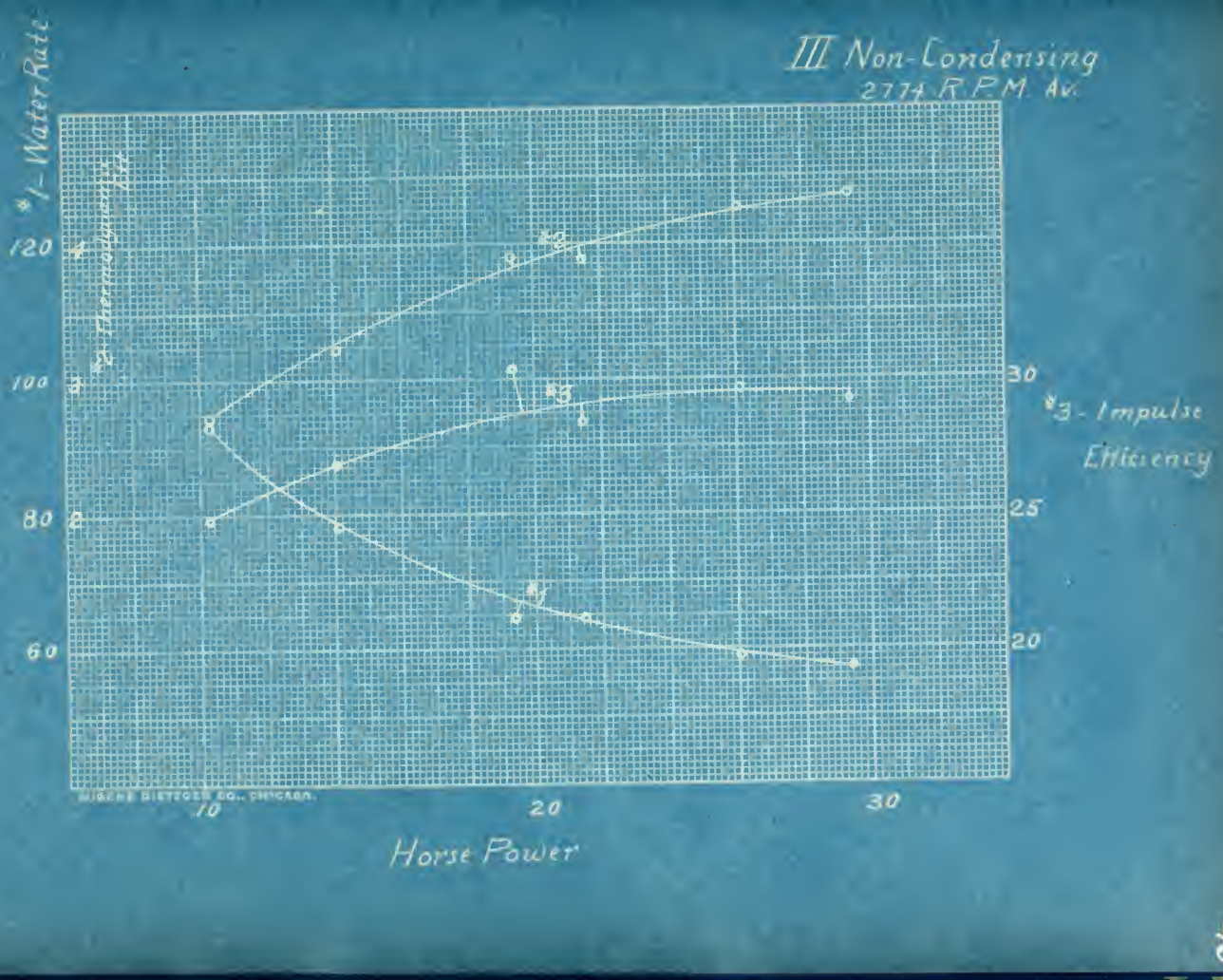

V Non-Condensing
2597 R.P.M. Av.
#1-Horse Power
#2-Water Rate
#4-Impulse Efficiency
Pressure
30
120
20
100
80
10
60
30
25
20
30
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

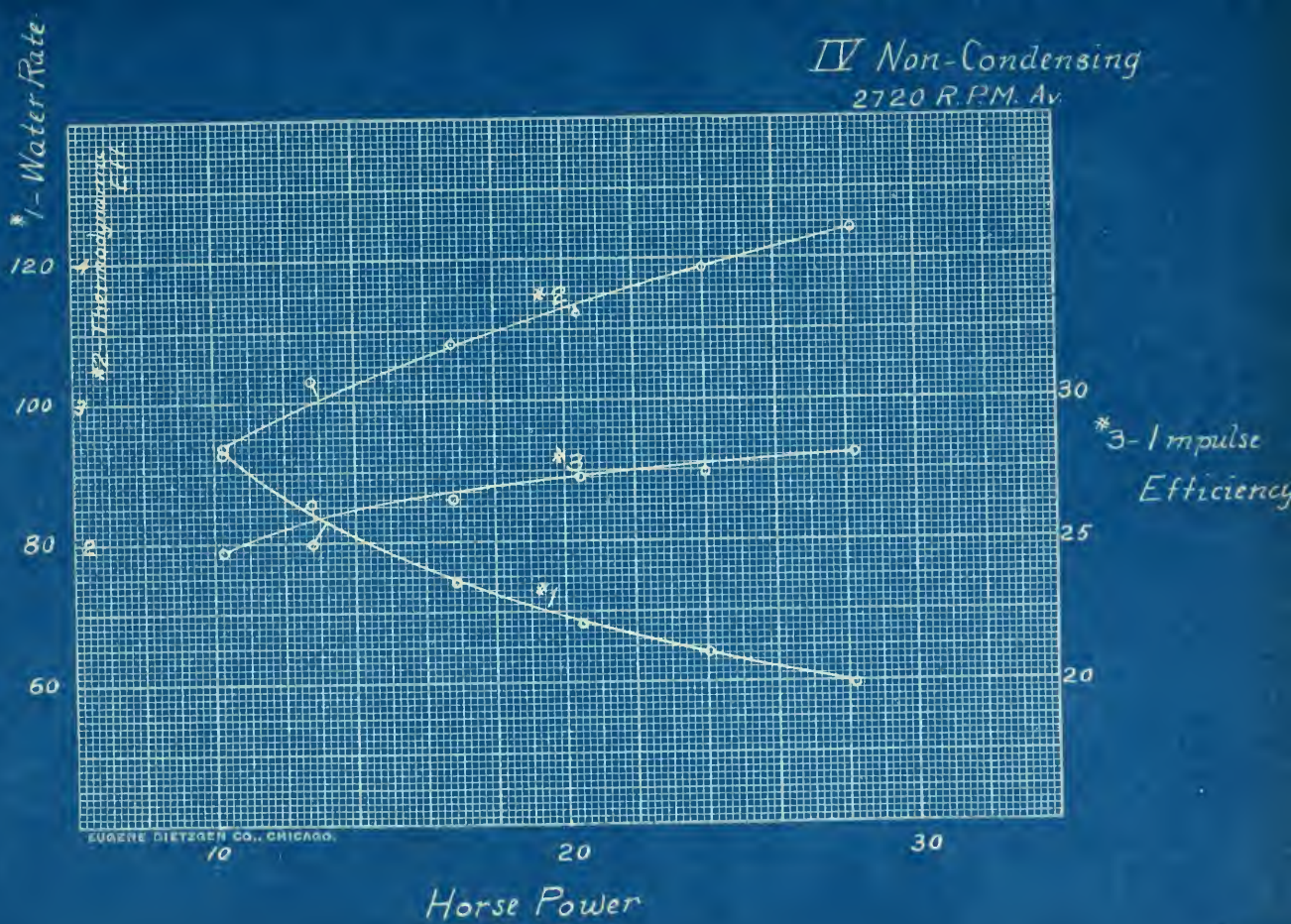

VI Non-Condensing
2499 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#3 - Thermodynamic Efficiency
#4 - Impulse Efficiency
Pressure
30
120
100
80
60
20
10
3
2
25
50
60
70
80
90
100
EUGENE DIETZGEN CO., CHICAGO.

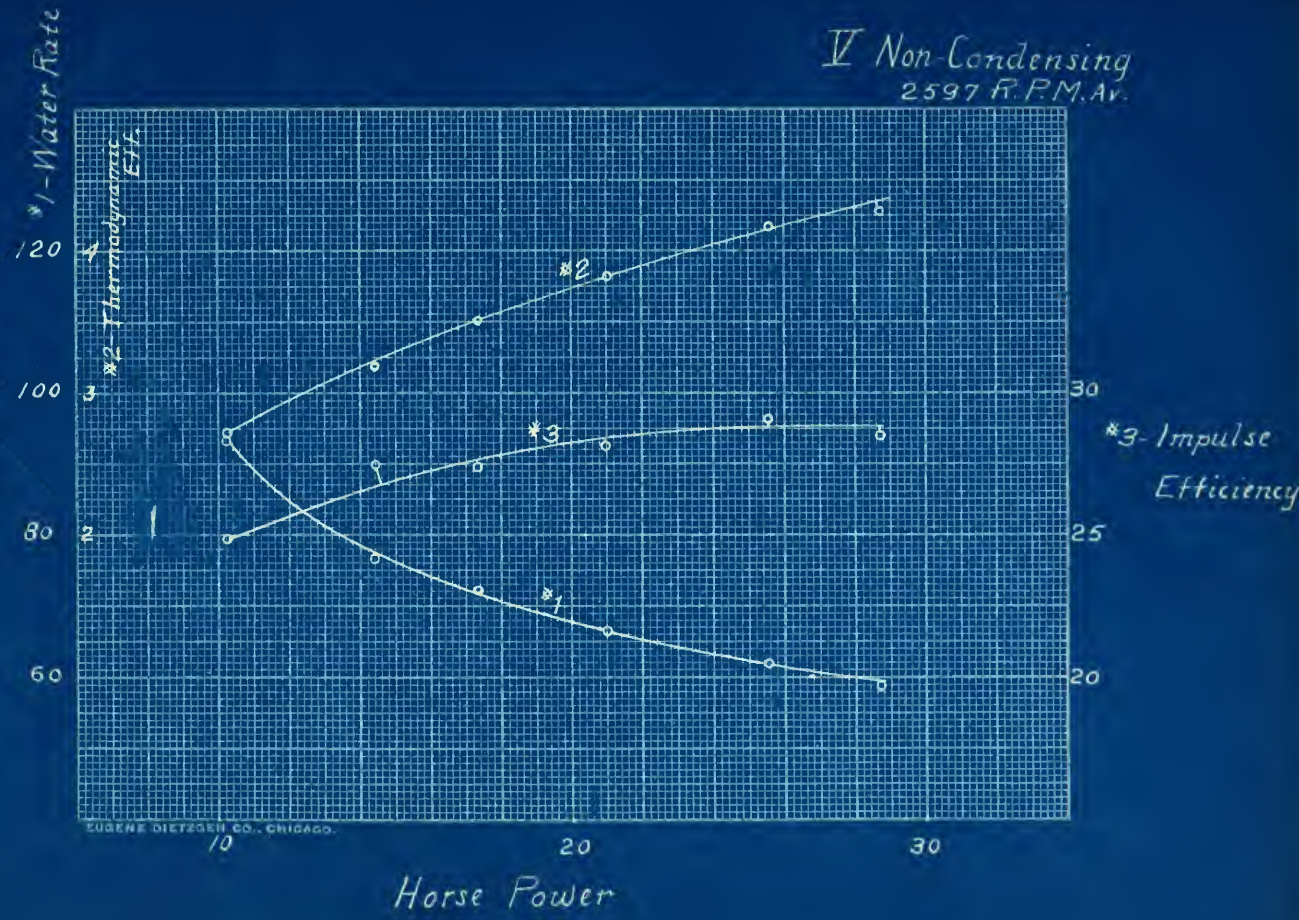

VII Non-Condensing
2375 R.P.M. Av.
#1 - Horse Power
#2 - Water Rate
#3 - Thermodynamic Efficiency
#4 - Impulse Efficiency
30
120
100
80
60
20
10
30
25
20
50
60
70
80
90
100 Pressure
EUGENE DIETZGEN CO., CHICAGO.

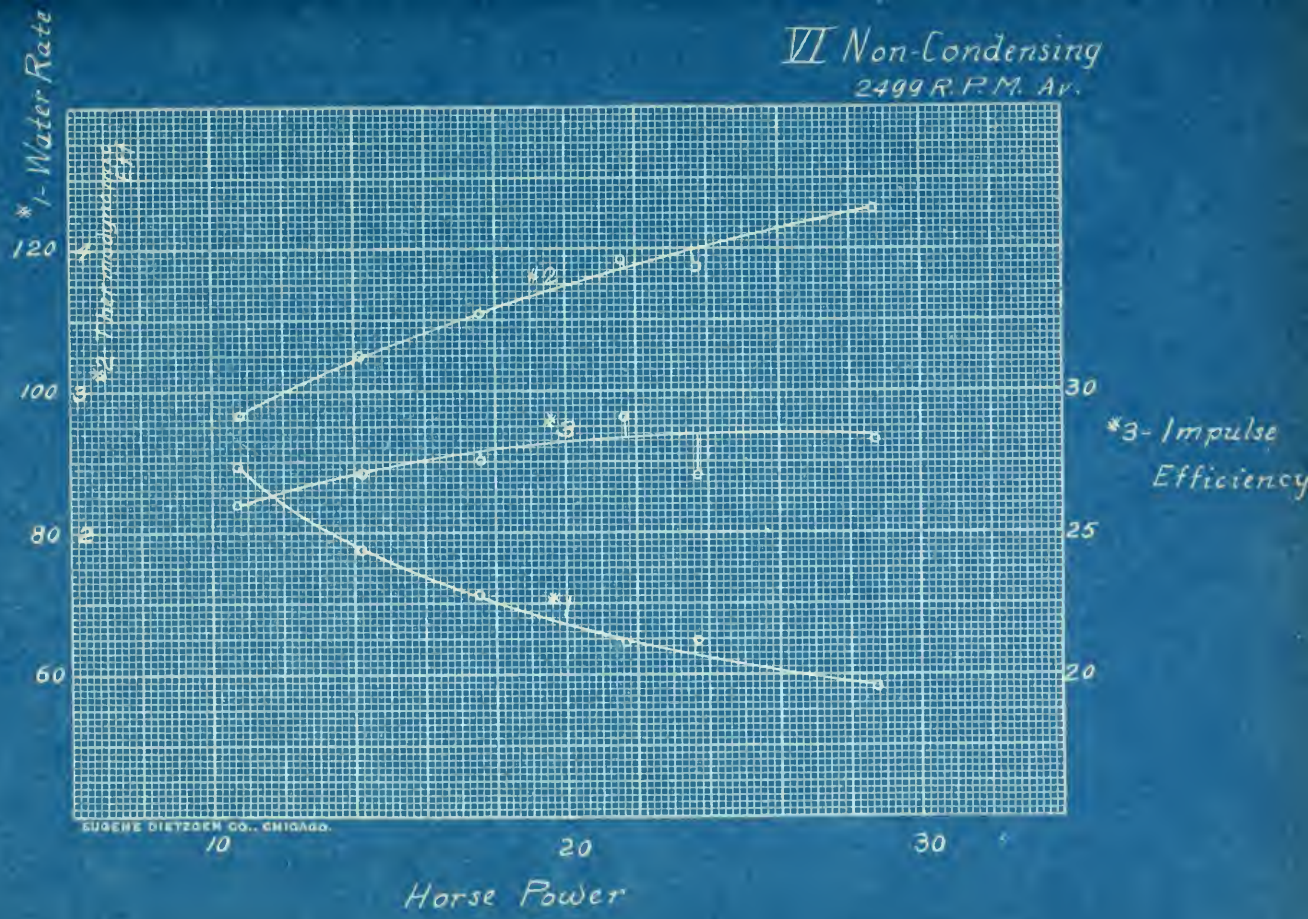

I Non-Condensing
2952 R.P.M Av.
#1 - Water Rate
#2 Thermodynamic Eff.
#3 - Impulse Efficiency
Horse Power
120
100
80
60
4
3
2
30
25
20
10
20
30
1
2
3
DIETZGEN CO., CHICAGO.

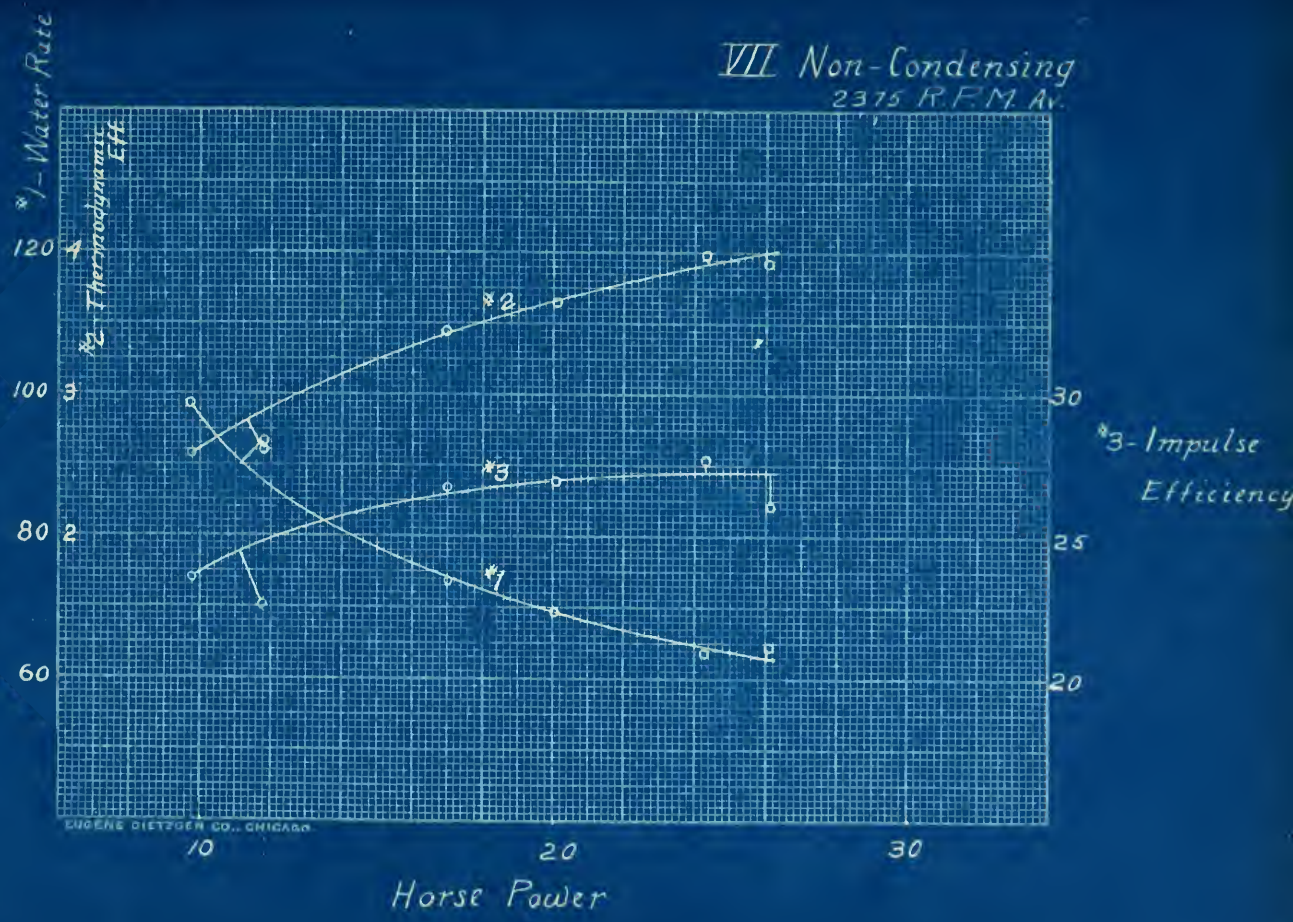

II Non-Condensing
2890 R.P.M Av.
#1 - Water Rate
#2 Thermodynamic Eff.
#3 - Impulse Efficiency
120
100
80
60
30
25
20
10
20
30
Horse Power
EUGENE DIETZGEN CO., CHICAGO.


III Non-Condensing
2774 R.P.M. Av.
#1 - Water Rate
120
100
80
60
30
25
20
#3 - Impulse Efficiency
10
20
30
Horse Power
MICHLE BIERTGER CO., CHICAGO.

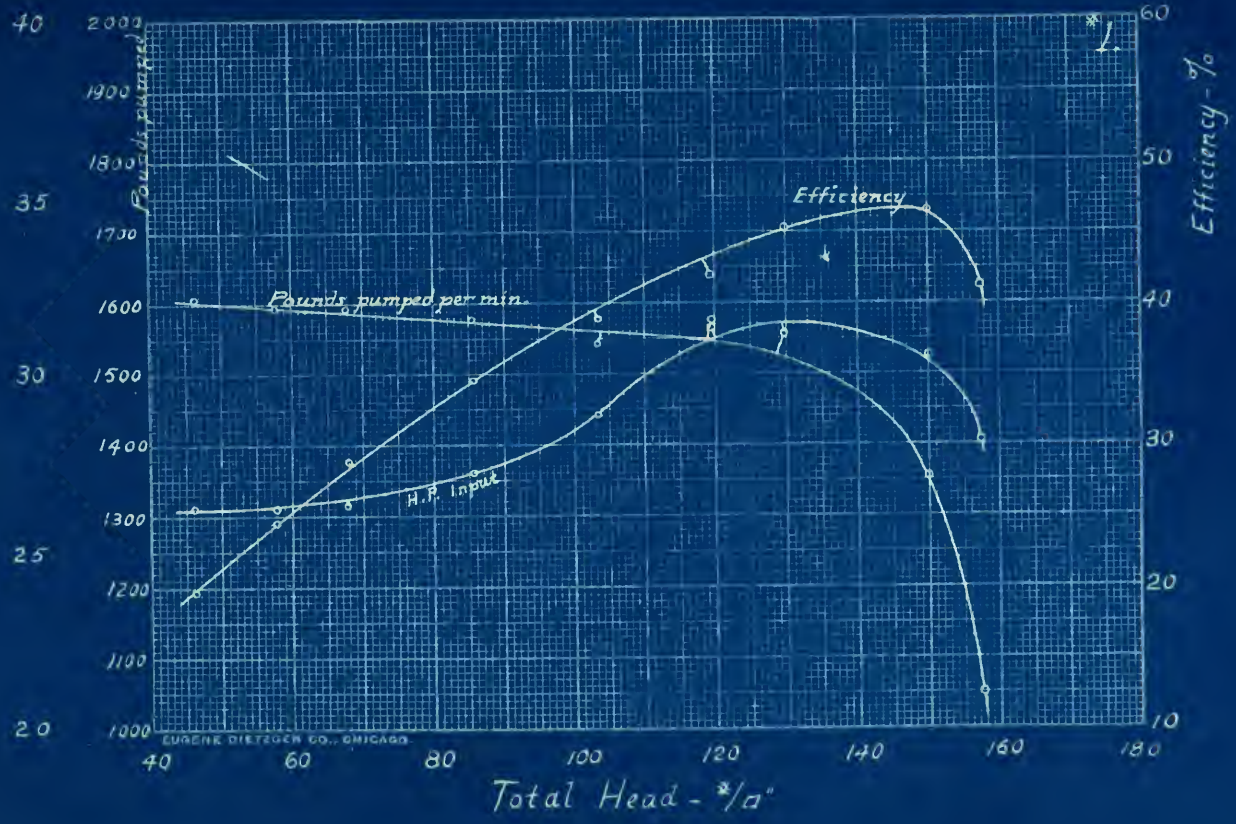

IV Non-Condensing
2720 R.P.M. Av.
*1-Water Rate
*2-Thermodynamic Efficiency
*3-Impulse Efficiency
120
100
80
60
30
25
20
10
20
30
Horse Power
EUGENE DIETZGEN CO., CHICAGO.


V Non-Condensing
2597 R.P.M. Av.
#1 - Water Rate
#2 - Thermodynamic Eff.
#3 - Impulse Efficiency
#1
#2
#3
120
100
80
60
30
25
20
10
20
30
Horse Power
EUGENE DIETZGEN CO., CHICAGO.

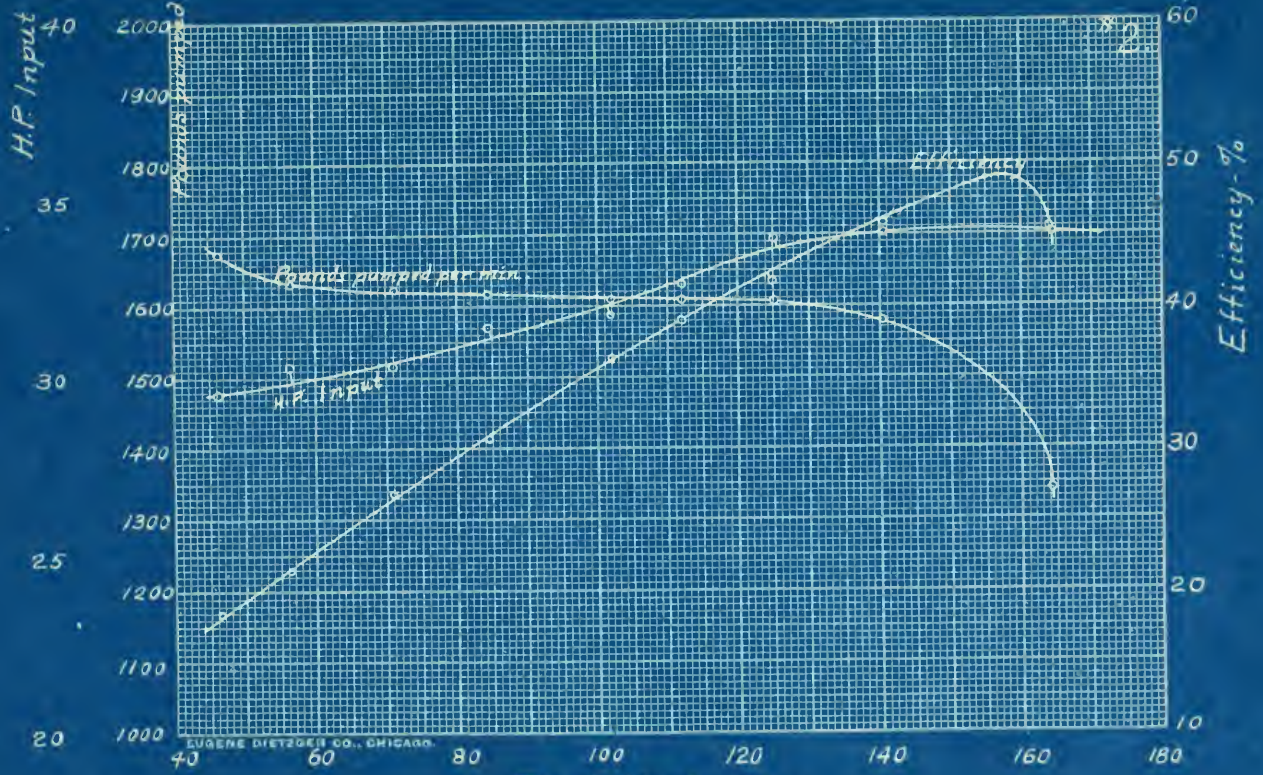

VI Non-Condensing
2499 R.P.M. Av.
*1- Water Rate
*2- Thermal Efficiency
*3- Impulse Efficiency
120
100
80
60
30
25
20
10
20
30
Horse Power
EUGENE DIETZGEN CO., CHICAGO.


VII Non-Condensing
2375 R.P.M. Av.
*1 - Water Rate
*2 - Thermodynamic Eff.
*3 - Impulse Efficiency
120
100
80
60
4
3
2
30
25
20
10
20
30
Horse Power
EUGENE DIETZGEN CO., CHICAGO

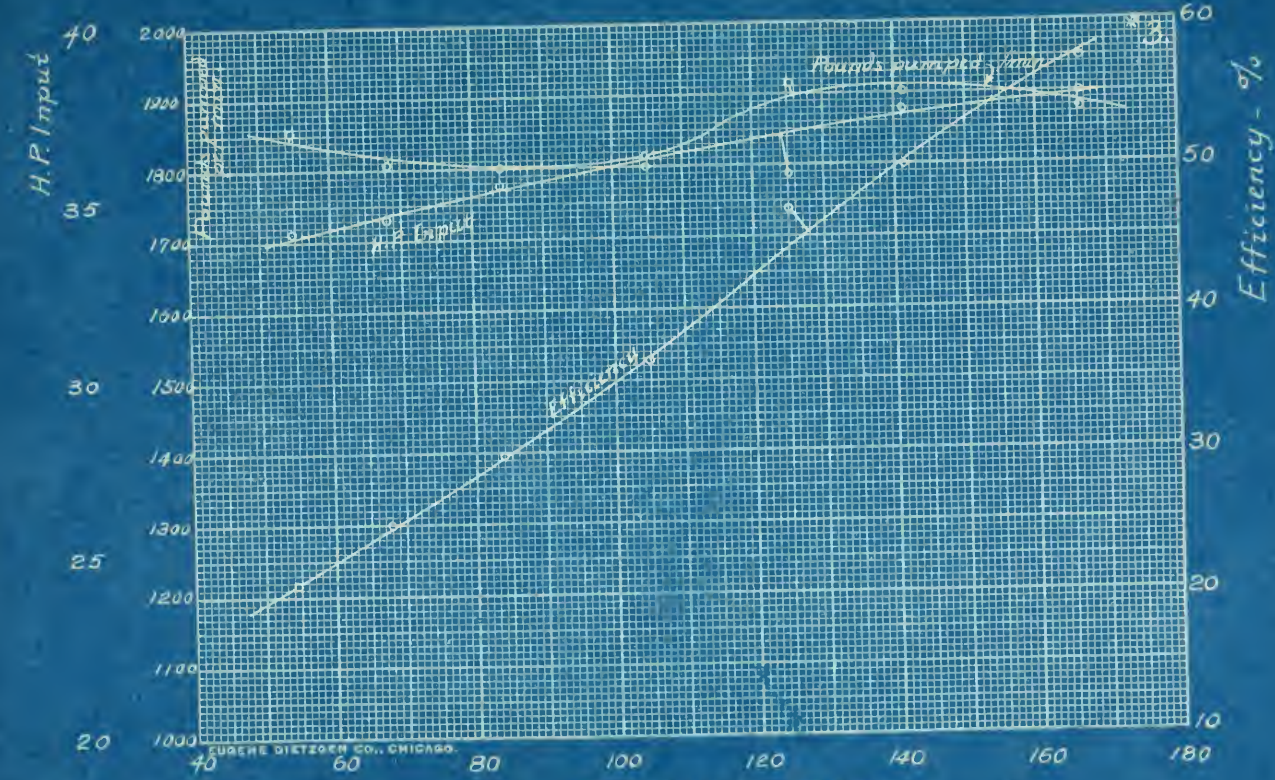
Test - 1

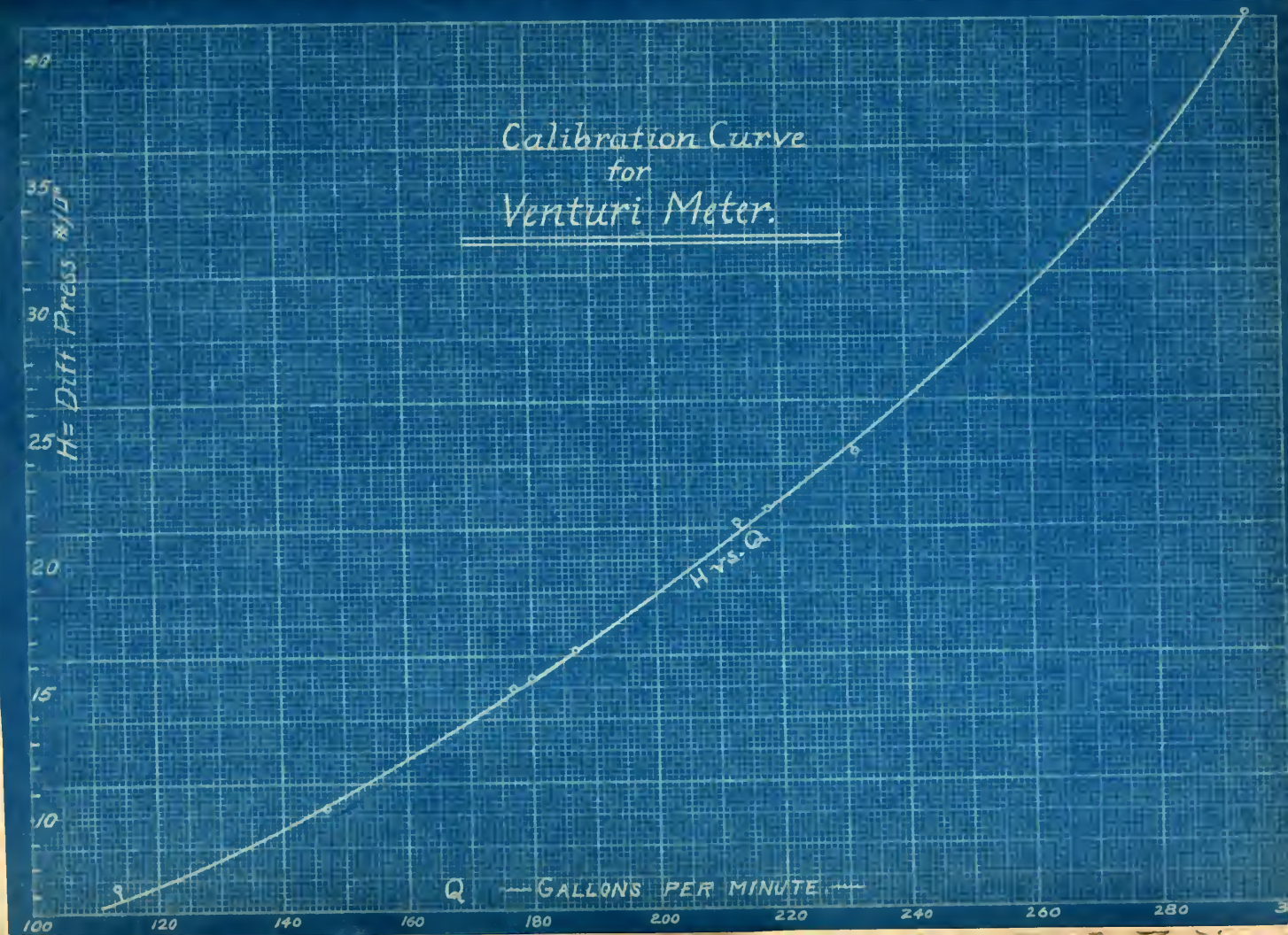

H.P. Input
Pounds pumped per min.
Efficiency - %
Efficiency
Pounds pumped per min.
H.P. Input
Total Head - ft/a"
EUGENE DIETZGEN CO., CHICAGO.
40
35
30
25
20
2000
1900
1800
1730
1600
1500
1400
1300
1200
1100
1000
60
50
40
30
20
10
40
60
80
100
120
140
160
180

Test #2.


H.P. Input
Pounds pumped per min.
Efficiency - %
Efficiency
Pounds pumped per min.
H.P. Input
40
35
30
25
20
2000
1900
1800
1700
1600
1500
1400
1300
1200
1100
1000
60
50
40
30
20
10
40
60
80
100
120
140
160
180
Total Head - #/□".
EUGENE DIETZGEN CO., CHICAGO.

Test #3.


H.P. Input
Efficiency - %
Total Head - "/o"
Pounds evaporated / hr.
H.P. Input
Efficiency
EUGENE DIETZGEN CO., CHICAGO.


Calibration Curve
for
Venturi Meter.
H = Diff Press #/□"
H vs. Q
Q — GALLONS PER MINUTE —
40
35
30
25
20
15
10
100
120
140
160
180
200
220
240
260
280

Index For Steam Turbines.

	Page
Advantages	1
Applications	1
Auxiliaries	1
Blades	1-2
Classification	2
Comparison	2
Condensers for	3
Design	3
Descriptive	3-11
Allis-Chalmers	
Crocker	
Curtis	
De Laval	
Hamilton-Holzworth	
Miscellaneous	
Parsons	
Rateau	
Riedler-Stumpf	
Warren	
Westinghouse-Parsons	
Zoelly	
Development	12
Efficiency	12
Exhaust steam turbines	13
Floor Space	13
Governing	13

Index For Steam Turbines.

	Page
Advantages	1
Applications	1
Auxiliaries	1
Blades	1-2
Classification	2
Comparison	2
Condensers for	3
Design	3
Description	3-11
Allis-Chalmers	
Crocker	
Curtis	
De Laval	
Hamilton-Holzworth	
Miscellaneous	
Parsons	
Rateau	
Riedler-Stumpf	
Warren	
Westinghouse-Parsons	
Zoelly	
Development	12
Efficiency	12
Exhaust steam turbines	13
Floor Space	13
Governing	13

Installations 13-17

Curtis

De Laval

Parsons

Westinghouse-Parsons

Manufacture 18

Curtis

De Laval

Parsons

Riedler-Stumpf

Marine turbines 18-19

Operation 20

Progress 21

Starting 21

Tests 21-25

Curtis

De Laval

Miscellaneous

Parsons

Westinghouse-Parsons

Theory 25-26

Uses 27

Vacuum 27

Installations 13-17
Curtis
De Laval
Parsons
Westinghouse-Parsons
Manufacture 18
Curtis
De Laval
Parsons
Riedler-Stumpf
Marine turbines 18-19
Operation 20
Progress 21
Starting 21
Tests 21-25
Curtis
De Laval
Miscellaneous
Parsons
Westinghouse-Parsons
Theory 25-26
Uses 27
Vacuum 27

STEAM TURBINES.

ADVANTAGES.

Advantages of steam turbines 1 C.
Engineer U.S.A. 39 : 532 Sept. 15, 1901.

APPLICATIONS.

#Steam turbine for dynamo propulsion
American Electrician 13 : 504 Oct. 1901.

#Recent steam turbine applications (C. L. Parsons) 14 C.
Cassier's Magazine 24 : 64 May 1903

#High speed work in electrical engines (B. A. Behrend) 3 C.

Data on the use and performance of steam turbines (F.N.Bushnell)
Machinery 2 C. 12 : 161 Nov. 1905

Steam turbines (W. E. Boilean)
Western Electrician 36 : 412 May 27, 1905

AUXILIARIES.

Power required for condensing auxiliaries in a steam turbine plant (J. R. Bibbins)
Power 10 C. 25 : 90 x Feb. 1905

BLADES.

#Durability of the vanes in Westinghouse-Parsons steam turbine (Westinghouse Machine Co.)

Engineer U.S.A. 5 C. 42 : 319 May 1, 1905

STEAM TURBINES.

ADVANTAGES.

Advantages of steam turbines 1 C.
Engineer U.S.A. 39 : 332 Sept. 15, 1901.

APPLICATIONS.

*Steam turbine for dynamo propulsion
American Electrician 13 : 504 Oct. 1901.

*Recent steam turbine applications (C. L. Parsons) 14 C.
Cassier's Magazine 24 : 64 May 1903

*High speed work in electrical engines (B. A. Behrend) 3 C.

Data on the use and performance of steam turbines (E.M.Bruen.ell)
Machinery 2 C. 12 : 161 Nov. 1905

Steam turbines (W. R. Boileau)
Western Electrician 36 : 412 May 27, 1905

AUXILIARIES.

Power required for condensing auxiliaries in a steam turbine plant (J. R. Bibbins)
Power 10 C. 25 : 90 x Feb. 1905

BLADES.

*Durability of the vanes in Westinghouse-Parsons steam turbine (Westinghouse Machine Co.)

Engineer U.S.A. 8 C. 42 : 319 May 1, 1905

Engineering News 3 C. 53 : 359 Apr. 6, 1905
Engineering Record 4 C. 51 : 418 Apr. 8, 1905
" " 2 C. 51 : 476 Apr. 29, 1905
St. Ry. Journal 25 : 669 Apr 8, 1905

Interesting photographs of steam turbine blades
Machinery 3 C. 11 : 471 May 1905

CLASSIFICATION.

#Classification and peculiarities of the steam turbine
Engineering Record 6 C. 52 : 291 Sept. 9, 1905

COMPARISON.

Comparison between steam turbine and the reciprocating engine (Seymour & Hodgkinson)
Electrical World 6 C. 43 : 651 Apr. 2, 1904
2 C. 825 23, 1904
2 C. 774 30, 1904
1 C. 915 May 14, 1904

Reciprocating engine vs. turbine (W. C. Webber)
Engineer U.S.A. 1 C. 42 : 711 Nov. 1, 1905

Reciprocating sets vs. turbo generators (I. W. Chebb)
Power 6 C. 24 : 232 Apr. 1904

Reciprocating sets vs. turbo generators (Hodgkinson)
Power 2 C. 24 : 298 May 1904

Economy of the reciprocating engine at light loads compared with the steam turbine (J. A. Seymour)
Power 7 C. 24 : 241 Apr. 1904

Steam turbine pumps for water works (D. H. Maury)
Engineering Record 2 C. 52 : 137 Aug. 5, 1905.

Engineering News 3 C. 53 : 359 Apr. 6, 1905
Engineering Record 4 C. 51 : 418 Apr. 8, 1905
" " 2 C. 51 : 476 Apr. 29, 1905
St. Ry. Journal 25 : 509 Apr. , 1905

Interesting photographs of steam turbine blades
Machinery 3 C. 11 : 471 May 1905

CLASSIFICATION.
Classification and peculiarities of the steam turbine
Engineering Record 6 C. 52 : 291 Sept. 9, 1905

COMPARISON.
Comparison between steam turbine and the reciprocating engine
(Seymour & Hodgkinson)
Electrical World 6 C. 43 : 651 Apr. 2, 1904
2 C. 825 23, 1904
2 C. 774 30, 1904
1 C. 915 May 14, 1904

Reciprocating engine vs. turbine (W. C. Webber)
Engineer U.S.A. 1 C. 42 : 711 Nov. 1, 1905

Reciprocating sets vs. turbo generators (I. W. Chubb)
Power 6 C. 24 : 232 Apr. 1904

Reciprocating sets vs. turbo generators (Hodgkinson)
Power 2 C. 24 : 298 May 1904

Economy of the reciprocating engine at light loads compared with
the steam turbine (A. A. Seymour)
Power 7 C. 24 : 241 Apr. 1904

Steam turbine pumps for water works (D. H. Berry)
Engineering Record 3 C. 52 : 137 Aug. 5, 1905.

CONDENSERS FOR?
See condensers.

DESIGN.
Some problems in steam turbine design (L. C. Lowenstein)
Engineering Record 3 C. 52 : 101 July 22, 1905

Effect of pressure on the DeLaval steam turbine (C.Garrison)
Engineering Record 3 C. 49 : 581 May 7, 1904

#The De Laval turbine (K. Anderson)
St. Ry. Journal 5 C. 20 : 988 Dec. 20, 1902

#Design of steam turbine discs (F.Foster)
Engineer Lond. 3 C. 97 : 34 Jan. 8, 1904

#Steam turbine discs (M. F. Fitzgerald)
Engineer Lond. 4 C. 97 : 481 May 13, 1904

DESCRIPTIVE
ALLISCHALMERS
#9000 H.P. steam turbine for the Brooklyn R.T.
St. Ry. Journal 26 : 894 Nov. 11, 1905

#Turbines in new Williamsburg power plant of Brooklyn R.T.Co.
St. Ry. Journal 4 C. 26 : 438 Sept. 23, 1905
Electrical World 1 C. 46 : 832 Nov. 11,

#Allis-Chalmers steam turbine
Western Electrician 1 C. 37 : 377 Nov. 11, 1905

CONDENSERS FOR?
See condensers.

DESIGN.
Some problems in steam turbine design (L. C. Lowenstein)
Engineering Record 3 C. 52 : 101 July 22, 1905

Effect of pressure on the Delaval steam turbine (C.Garrison)
Engineering Record 3 C. 49 : 581 May 7, 1904

#The De Laval turbine (K. Anderson)
St. Ry. Journal 5 C. 20 : 988 Dec. 20, 1902

#Design of steam turbine discs (P.Foster)
Engineer Lond. 3 C. 97 : 34 Jan. 8, 1904

#Steam turbine discs (M. F. Fitzgerald)
Engineer Lond. 4 C. 97 : 481 May 13, 1904

DESCRIPTIVE
ALLIS-CHALMERS
#5000 H.P. steam turbine for the Brooklyn R.T.
St. Ry. Journal 26 : 894 Nov. 11, 1905

#Turbines in new Williamsburg power plant of Brooklyn R.T.Co.
St. Ry. Journal 4 C. 26 : 438 Sept. 23, 1905
Electrical World 1 C. 46 : 832 Nov. 11,

#Allis-Chalmers steam turbine
Western Electrician 1 C. 37 : 377 Nov. 11, 1905

CROCKER

Crocker steam turbine (F. C. Crocker)
Electrical World 2 C. 44 : 336 Aug. 27, 1904

Crocker steam turbine
Engineering Record 1 C. 50 : 290 Sept. 3, 1904

#Crocker-Wheeler-Terry steam turbine
Western Electrician 1 C. 36 : 293 Apr. 15, 1905
Machinery 2 C. 12 : 35 Sept. 1905

CURTIS.

Recent steam turbine developments (W.L.R.Emmet)
Electrical World 42 : 434 Sept. 12, 1903

#Steam turbine in modern engineering (W.L.R.Emmet)
Engineering News 3 C. 51 : 552 June 9, 1904
Power 24 : 418 July 1904
Engineering 78 : 97 July 15, 1904
A.S.M.E. 14 pp 25 : 1040 1904

#Advantages of the steam turbines for textile mills (A.R.Dodge)
Engineering News 4 C. 50 : 359 Oct. 22, 1903
Western Electrician 4 C. 33 : 297 Oct. 17, 1903
Electrical World 4 C. 42 : 606 Oct.10, 1903
St. Ry. Journal 4 C. 22 : 697 Oct. 10, 1903

Discussion on the steam turbine at the American St.Ry. Ass'n.
Engineering News 3 C. 52 : 355 Oct. 20, 1904

Recent steam turbine development (W.L.R.Emmet)
St. Ry. Journal 22 : 539 Sept. 12, 1903
Western Electrician 6 C. 33 : 200 Sept. 12, 1903

#New steam turbine development (W.L.R.Emmet)
Western Electrician 4 C. 34 : 393 May 14, 1904
St. Ry. Journal 7 C. 23 : 742 May 14, 1904

#Curtis steam turbine- General Electric Co.
American Electrician 2 C 15 : 244 May 1903

#Curtis steam turbine
Engineering 5 C. 77 : 181 Feb. 5, 1904

#Curtis steam turbine
Engineer U.S.A. 2 C. 40 : 499 June 15, 1903

#Step bearing of the Curtis steam turbine
Electrical World 45 : 1136 June 17, 1905

CROCKER

Crocker steam turbine (F. C. Crocker)

Electrical World & C. 44 : 336 Aug. 27, 1904

Crocker steam turbine

Engineering Record 1 C. 50 : 290 Sept. 3, 1904

#Crocker-Wheeler-Terry steam turbine

Western Electrician 1 C. 36 : 293 Apr. 15, 1905
Machinery 2 C. 12 : 35 Sept. 1905

CURTIS.

Recent steam turbine developments (W.L.R.Emmet)

Electrical World 42 : 434 Sept. 12, 1903

#Steam turbine in modern engineering (W.L.R.Emmet)

Engineering News 3 C. 51 : 552 June 9, 1904
Power 24 : 418 July 1904
Engineering 78 : 97 July 15, 1904
A.S.M.E. 14 pp 25 : 1040 1904

#Advantages of the steam turbines for textile mills (A.R.Dodge)

Engineering News 4 C. 50 : 359 Oct. 22, 1903
Western Electrician 4 C. 33 : 297 Oct. 17, 1903
Electrical World 4 C. 42 : 606 Oct.10, 1903
St. Ry. Journal 4 C. 22 : 397 Oct. 10, 1903

Discussion on the steam turbine at the American St.Ry. Ass'n.

Engineering News 3 C. 52 : 355 Oct. 20, 1904

Recent steam turbine development (W.L.R.Emmet)

St. Ry. Journal 22 : 539 Sept. 12, 1903
Western Electrician 6 C. 33 : 200 Sept. 12, 1903

#New steam turbine development (W.L.R.Emmet)

Western Electrician 4 C. 34 : 393 May 14, 1904
St. Ry. Journal 7 C. 23 : 742 May 14, 1904

#Curtis steam turbine- General Electric Co.

American Electrician 2 C 15 : 244 May 1903

#Curtis steam turbine

Engineering 5 C. 77 : 181 Feb. 5, 1904

#Curtis steam turbine

Engineer U.S.A. 2 C. 40 : 499 June 15, 1903

#Step bearing of the Curtis steam turbine

Electrical World 42 : 1136 June 7, 1905

Curtis steam turbines
Iron Age 2 C. 71 : 18 May 21, 1903

#Curtis steam turbine
Power 8 C. 23 : 254 May 1903

Mr. Emmet on the steam turbine
Western Electrician 4 C. 33 : 159 Aug. 29, 1903

Turbine developments
Power 24 : 244 Apr. 1904

#Steam turbines at the St.Louis Exposition
Power 14 C. 24 : 744 Dec. 1904

#Steam turbine reports to the N.E.L.A. (Elgin, Sargent & Dunham)
Western Elect. 9 C. 34 : 463 June 4, 1904

Steam turbine discussion at the 1904 meeting of the N.E.L.A.
Western Electrician 2 C. 34 : 489 June 11, 1904

Steam turbine (R. H. Rice)
Western Elect. 3 C. 35 : 333 Oct. 22, 1904
Engineering Record 5 C. 50 : 448 " 15, "

#The steam turbine in central station practice (W.L.R.Emmet)
Electrical Age 12 C. 33 : 336 Nov. 1904

Recent improvements in the Curtis steam turbine (W.L.R.Emmet)
St. Ry. Journal 23 : 862 June 4, 1904

#Emmet-Junggrem turbo generator
Western Elect. 1 C. Oct. 29, 1904

#Curtis steam turbine (W.L.R.Emmet)
Electrical World 6 C. 41 : 609 Apr. 11, 1903
Engineering Record 5 C. 47 : 371,393 Apr. 11, 1903
St. Ry. Journal 10 C. 21 : 564 Apr. 11, 1903
Western Elect. 5 C. 32 : 308 Apr. 18, 1903

#Curtis steam turbine
Electrical World 2 C. 41 : 857 May 23, 1903
1 C. 859

Curtis steam turbines
Iron Age 2 C. 71 : 18 May 21, 1903

*Curtis steam turbine
Power 8 C. 23 : 254 May 1903

r. Emmet on the steam turbine
Western Electrician 4 C. 33 : 159 Aug. 29, 1903

Turbine developments
Power : 24 : 244 Apr. 1904

*Steam turbines at the St.Louis Exposition
Power 14 C. 24 : 744 Dec. 1904

*Steam turbine reports to the N.E.L.A. (Elgin, Sargent & Dunham)
Western Elect. 9 C. 34 : 463 June 4, 1904

Steam turbine discussion at the 1904 meeting of the N.E.L.A.
Western Electrician 2 C. 34 : 489 June 11, 1904

Steam turbine (R. H. Rice)
Western Elect. 3 C. 35 : 353 Oct. 22, 1904
Engineering Record 5 C. 50 : 448 " 15, "

*The steam turbine in central station practice (W.L.R.Emmet)
Electrical Age 12 C. 33 : 336 Nov. 1904

Recent improvements in the Curtis steam turbine (W.L.R.Emmet)
St. Ry. Journal 23 : 862 June 4, 1904

*Emmet-Junggren turbo generator
Western Elect. 1 C. Oct. 29, 1904

*Curtis steam turbine (W.L.R.Emmet)
Electrical World 6 C. 41 : 609 Apr. 11, 1903
Engineering Record 5 C. 47 : 373, 393 Apr. 11, 1903
St. Ry. Journal 10 C. 21 : 564 Apr. 11, 1903
Western Elect. 5 C. 32 : 308 Apr. 18, 1903

*Curtis steam turbine
Electrical World 2 C. 41 : 857 May 23, 1903
1 C. 859

DE LAVAL.

#De Laval steam turbine

Amer. Elect. 3 C.	13 : 553	Nov. 1901
Electrical World 9 C.	37 : 246	Feb. 9, 1901
	38 : 693	Oct. 26, 1901
Engineer U.S.A. 3 C.	38 : 420	Nov. 1, 1901
2 C.	40 : 499	June 15, 1903
Engineering 2 C.	70 : 149	Aug. 3, 1900
Engineering News 3 C.	46 : 315	Oct. 24, 1901
St. Ry. Journal 3 C.	18 : 704	Nov. 2, 1901
St. Ry. Review 2 C.	11 : 837	Nov. 15, 1901
Western Elect. 3 C.	29 : 278	Oct. 26, 1901

The De Laval steam turbine in America (J. L. Mohum)

Cassier's Magazine 19 C.	28 : 103	June 1905.

#Types of De Laval turbine units

Electrical World 3 C.	46 : 194	July 29, 1905

De Laval steam turbine (Lea and Meden)

Engineering 4 C.	77 : 846	June 17, 1904
Engineering News 5 C.	51 : 551	" 9, 1904
Iron Age 3 C.	73 : 16	" 2, 1904
Power 3 C.	24 : 415	July 1904
A.S.M.E. 17 p.	25 : 1056	1904

#De Laval turbine description

Engineering Record 3 C.	44 : 371	Oct. 19, 1901

#Steam turbine report to the N.E.L.A. (Elgin, Sargent & Dunham)

Western Electrician 9 C.	34 : 463	June 4, 1904

DE LAVAL.

#De Laval steam turbine

Amer. Mach. 3 C. 13 : 553 Nov. 1901
Electrical World 37 : 246 Feb. 9, 1901
9 C. 38 : 693 Oct. 26, 1901
Engineer U.S.A. 3 C. 38 : 420 Nov. 1, 1901
2 C. 40 : 499 June 15, 1903
Engineering 2 C. 70 : 149 Aug. 3, 1900
Engineering News 3 C. 46 : 315 Oct. 24, 1901
St. Ry. Journal 3 C. 18 : 704 Nov. 2, 1901
St. Ry. Review 2 C. 11 : 837 Nov. 15, 1901
Western Mach. 3 C. 29 : 278 Oct. 20, 1901

The De Laval steam turbine in America (J. L. Mohun)
Cassier's Magazine 19 C. 28 : 103 June 1900.

#Types of De Laval turbine units

Electrical World 3 C. 46 : 194 July 29, 1905

De Laval steam turbine (Lea and Yeden)

Engineering 4 C. 77 : 846 June 17, 1904
Engineering News 5 C. 51 : 551 " 9, 1904
Iron Age 3 C. 73 : 16 " 2, 1904
Power 3 C. 24 : 415 July 1904
A.S.M.E. 17 p. 25 : 1056 1904

#De Laval turbine description

Engineering Record 3 C. 44 : 371 Oct. 15, 1901

#Steam turbine report to the N.E.L.A. (Elgin, Sargent & Dunham)

Western Electrician 9 C. 34 : 463 June 4, 1904

HAMILTON-HOLZWORTH.

#Hamilton-Holzworth steam turbine

American Electrician 5 C	16 : 549		Oct. 1904
Electrical Age 3 C.	33 : 308		Oct. 1904
Engineering News 1 C.	54 : 494		1905
Engineering Record 4 C.	50 : 405		Oct. 1, 1904
Iron Age 6 C.	74 : 6		Sept.29, 1904
Power 6 C.	24 : 659		Nov. 1904
St. Ry. Review 2 C.	14 : 649		Sept. 20, 1904
Machinery 4 C.	11 : 134		Nov. 1904
Engineer U.S.A. 5 C.	41 : 690		Oct. 1, 1904

MISCELLANEOUS MAKES.

#Triple expansion steam turbine

Engineer U.S.A. 1 C.	37 : 5	Jan. 1, 1900

#High power steam turbine

Power 4 C.	24 : 98	Feb. 1904

#Practical data on Eurpoean practice with steam turbines(F.Koest

Engineering Record 3 C.	51 : 10	Jan. 7, 1905

#Data of the A.E.C. steam turbine (F. Koester)

Electrical World 2 C.	45 : 344	Feb. 18, 1905

#Curious turbo generators

Western Electrician 1 C.	33 : 329	Oct. 31, 1903

The Bucholtz steam turbine

Electrical Age 1 C.	32 : 96	Feb. 1904

#Kerr compound steam turbine

Power 2 C.	25 : 66	Feb. 1905

#Review of steam turbine patents (Con. art.)

Machinery	11 : 1	Sept. 1904
	115	Nov. 1904
	237	Jan. 1905
	291	Feb. 1905

#Hamilton-Holzworth steam turbine

American Electrician 5 C 16 : 649 Oct. 1904
Electrical Age 3 C. 33 : 308 Oct. 1904
Engineering News 1 C. 54 : 494 1905
Engineering Record 4 C. 50 : 605 Oct. 1, 1904
Iron Age 6 C. 74 : 6 Sept.29, 1904
Power 6 C. 24 : 659 Nov. 1904
St. Ry. Review 2 C. 14 : 649 Sept. 20, 1904
Machinery 4 C. 11 : 134 Nov. 1904
Engineer U.S.A. 5 C. 41 : 690 Oct. 1, 1904

MISCELLANEOUS MAKES.

#Triple expansion steam turbine

Engineer U.S.A. 1 C. 37 : 5 Jan. 1, 1900

#High power steam turbine

Power 4 C. 24 : 98 Feb. 1904

#Practical data on European practice with steam turbines(T.Rose

Engineering Record 3 C. 51 : 10 Jan. 7, 1905

#Data of the A.M.C. steam turbine (F. Rosater)

Electrical World 2 C. 45 : 344 Feb. 18, 1905

#Curious turbo generators

Western Electrician 1 C. 33 : 329 Oct. 31, 1903

The Bucholts steam turbine

Electrical Age 1 C. 32 : 96 Feb. 1904

#Kerr compound steam turbine

Power 2 C. 25 : 66 Feb. 1905

#Review of steam turbine patents (Con. art.)

Machinery 11 : 1 Sept. 1904
115 Nov. 1904
237 Jan. 1905
291 Feb. 1905

#Lindmark steam turbine
Machinery 3 C. 11 : 304 Feb. 1905

#The steam turbine (F. C. Gasche)
Engineer U.S.A. 6 C. 42 : 147 Feb.15, 1905

#New forms of the steam turbine (R. H. Smith)
Engineer (Lond) 4 C. 96 : 587 Dec. 18, 1903

PARSONS.

#Parsons steam turbine
Engineer U.S.A. 3 C. 40 : 500 June 15, 1903

#Williams-Robinson-Parsons steam turbine
Electrical World 2 C. 46 : 237 Aug. 5, 1905
St. Ry. Journal 3 C. 26 : 216 Aug. 5, 1905

#English records of Parsons steam turbine
St. Ry. Jour. 3 C. 23 : 859 June 4, 1904

RATEAU.

#Different applications of the steam turbine (A.Rateau)
Engineering News 15 C. 51 : 544 June 9,1904
Engineer 18 C. 77 : 863 June 17, 1904

Eng

*Lindmark steam turbine
Machinery 3 C. 11 : 304 Feb. 1905

*The steam turbine (E. C. Geache)
Engineer U.S.A. 6 C. 42 : 147 Feb.15, 1905

*New forms of the steam turbine (R. H. Smith)
Engineer (Lond) 4 C. 96 : 587 Dec. 18, 1903

PARSONS.

*Parsons steam turbine
Engineer U.S.A. 3 C. 40 : 500 June 15, 1903

*Williams-Robinson-Parsons steam turbine
Electrical World 2 C. 46 : 237 Aug. 5, 1905
St. Ry. Journal 3 C. 26 : 216 Aug. 5, 1905

*English records of Parsons steam turbine
St. Ry. Jour. 3 C. 23 : 859 June 4, 1904

RATEAU.

*Different applications of the steam turbine (A.Rateau)
Engineering News 15 C. 51 : 544 June 9,1904
Engineer 98 C. 77 : 865 June 17, 1904

Iron Age 12 C.	73	26	June 2, 1904
Power	24	417	July 1904
Western Elect. 4 C.	34	522	June 25, 1904
A.S.M.E. 44pp.	25	782	1904

#Recent developments of the steam turbine (A.Rateau)

Engineering Mag. 13pp.	26	49	Oct. 1903

#Rateau steam turbine

Electrical World 4 C.	42	133	July 25, 1903
Engineering 3 C.	76	105	July 17, 1903

Rateau steam turbine (A.Rateau)

Engineering	76	32	July 3, 1903

#Rateau steam turbine

Iron Age 3 C.	73	4	May 26, 1904
St. Ry. Journal 5 C.	21	596	Apr. 18, 1903

Operation of the Rateau turbine

St. Ry. Journal 2 C.	22	118	July 25, 1903

RIEDLER-STUMPF

Riedler-Stumpf turbine

Electrical World 1 C.	42	845	Nov. 21, 1903
#Engineering 9 C.	77	211	Feb. 12, 1904
#Engineering Record 3 C.	49	368	March 19, 1904

A Riedler steam turbine

Iron Age 1 col.	72	23	Nov. 26, 1903

#Riedler-Stumpf turbine and its applications

Power 13 C.	24	582	Oct. 1904

#Improvements in the Stumpf turbine

Western Electrician 1 C.	35	27	July 9, 1904

#Riedler-Stumpf steam turbine

Machinery 7 C.	10	301	

Iron Age 12 C. 73 : 26 June 2, 1904
Power 24 : 417 July 1904
Western Elect. 4 C. 34 : 522 June 25, 1904
A.S.M.E. 44pp. 25 : 782 1904

#Recent developments of the steam turbine (A.Rateau)
Engineering Mag. 13pp. 26 : 49 Oct. 1903

#Rateau steam turbine
Electrical World 4 C. 42 : 133 July 25, 1903
Engineering 3 C. 76 : 105 July 17, 1903

Rateau steam turbine (A.Rateau)
Engineering 76 : 32 July 3, 1903

#Rateau steam turbine
Iron Age 3 C. 73 : 4 May 26, 1904
St. Ry. Journal 5 C. 21 : 596 Apr. 18, 1903

Operation of the Rateau turbine
St. Ry. Journal 2 C. 22 : 118 July 25, 1903

RIEDLER-STUMPF

Riedler-Stumpf turbine
Electrical World 1 C. 42 : 845 Nov. 21, 1903
#Engineering 9 C. 77 : 211 Feb. 12, 1904
#Engineering Record 3 C. 49 : 598 March 19, 1904

A Riedler steam turbine
Iron Age 1 col. 72 : 23 Nov. 26, 1903

#Riedler-Stumpf turbine and its applications
Power 18 C. 24 : 582 Oct. 1904

#Improvements in the Stumpf turbine
Western Electrician 1 C. 35 : 27 July 9, 1904

#Riedler-Stumpf steam turbine
Engineer 7 C. 77 : 727

WARREN.

Warren-Crocker steam turbine (E. C. Crocker)
Engineer U.S.A. 4 C. 41 : 645 Sept. 15, 1904
Western Electrician 4 C. 35 : 151 Aug. 27, 1904

#Warren steam turbine
Power 3 C. 25 : 380 June 1905
Engineering News 4 C. 54 : 494 Nov. 9, 1905

WESTINGHOUSE-PARSONS.

Practical notes on the steam turbine (F.Hodgkinson)
American Electrician 16 : 335 July 1904
St. Ry. Review 1 C. 14 : 429 June 20, 1904

#Present development of the steam turbine (E.Yawger)
Electrical World 5 C. 40 : 906 Dec. 6, 1902

Reliability of the steam turbine (J. R. Bibbins)
Power 25 : 60 Jan. 1905

An epoch in the turbine art
Western Electrician 1 C. 37 : 72 July 22, 1905

Steam turbine power plants (J. R. Bibbins)
Engineering Record 5 C. 50 : 464 Oct. 15, 1904

#Steam turbine report to the N.E.L.A. by Elgin, Sargent & Dunham
Western Elect. 9 C. 34 : 463 June 4, 1904

#Westinghouse-Parsons steam turbine
American Electrician 12 C12 : 124 Mch. 1900

#New Westinghouse turbine for superheated steam
American Electrician 4 C.14 : 478 Oct. 1902

#Westinghouse 5000 K.W. turbo-generator set
American Electrician 4 C.16 : 60 Jan. 1904

Westinghouse-Parsons turbine
Electrical World 3 C. 43 : 925 May 14, 1904

#The Westinghouse turbine at St.Louis
Electrical World 4 C. 44 : 487 Sept. 17, 1904
1107 Dec. 24, 1904

WARREN.

Warren-Crocker steam turbine (H. C. Crocker)
Engineer U.S.A. 4 C. 41 : 645 Sept. 15, 1904
Western Electrician 4 C. 35 : 151 Aug. 27, 1904

*Warren steam turbine
Power 3 C. 25 : 380 June 1905
Engineering News 4 C. 54 : 494 Nov. 9, 1905

WESTINGHOUSE-PARSONS.

Practical notes on the steam turbine (H.Hodgkinson)
American Electrician 16 : 335 July 1904
St. Ry. Review 1 C. 14 : 429 June 20, 1904

*Present development of the steam turbine (H.Lawger)
Electrical World 5 C. 40 : 906 Dec. 3, 1902

Reliability of the steam turbine (I. R. Bibbins)
Power 25 : 60 Jan. 1905

An epoch in the turbine art
Western Electrician 1 C. 37 : 72 July 22, 1905

Steam turbine power plants (I. R. Bibbins)
Engineering Record 5 C. 50 : 464 Oct. 15, 1904

*Steam turbine report to the N.E.L.A. by Elgin, Sargent & Dunlap
Western Elect. 9 C. 34 : 463 June 3, 1904

*Westinghouse-Parsons steam turbine
American Electrician 12 C12 : 124 Mch. 1900

*New Westinghouse turbine for superheated steam
American Electrician 4 C.14 : 478 Oct. 1902

*Westinghouse 5000 K.W. turbo-generator set
American Electrician 4 C.16 : 60 Jan. 1904

Westinghouse-Parsons turbine
Electrical World 3 C. 43 : 925 May 14, 1904

*The Westinghouse turbine at St.Louis
Electrical World 4 C. 44 : 487 Sept. 17, 1904
1107 Dec. 24, 1904

#Westinghouse vertical steam turbine

Power 3 C.	24	265	May 1904
Western Electrician 3 C.	34	226	Mch. 19, 1904

#Steam turbines at the St.Louis Exposition

Power 14 C.	24	744	Dec. 1904

Commercial aspect of the steam turbine (E. H. Sniffin)

Electrical World 3 C.	40	623	Oct. 18, 1902
#St. Ry. Journal 12 C.	20	643	Oct. 18, 1902
#Western Elect. 7 C.	31	248	Oct. 11, 1902
		279	Oct. 18, 1902

#High power steam turbine

#Power 4 C.	24	98	Feb. 1904
#Engineering Record 4 C	49	27	Jan. 2,1902
#Electrical World 4 C.	43	59	Jan 2, 1904
#Iron Age 3 C.	76	1223	Nov. 9, 1905
Western Elect. 3 C.	34	38	Jan. 9, 1904
#Machinery	10	305	Feb. 1904

#Some theoretical and practical considerations of steam turbines (F. Hodgkinson)

A.S.M.E.	25	716	1904

ZOELLY.

Zoelly steam turbines

#Electrical World 4 C.	43	1123	June 11, 1904
#Engineering 8 C.	77	770	June 3, 1904
#Engineering Record 4 C.	49	707	June 4, 1904
#Western Elect. 3 C.	36	265	Apr. 8, 1905
#Machinery 6 C.	10	631	Aug. 1904

#Westinghouse vertical steam turbine

Power 3 C.	24	265	May 1904
Western Electrician 3 C.	36	226	Mch. 19, 1904

#Steam turbines at the St.Louis Exposition

Power 14 C.	24	744	Dec. 1904

Commercial aspect of the steam turbine (E. H. Smiffin)

Electrical World 3 C.	40	625	Oct. 18, 1902
#St. Ry. Journal 12 C.	20	643	Oct. 18, 1902
#Western Elect. 7 C.	31	248	Oct. 11, 1902
		279	Oct. 18, 1902

#High power steam turbine

#Power 4 C.	24	98	Feb. 1904
#Engineering Record 4 C	49	27	Jan. 2, 1902
#Electrical World 4 C.	43	59	Jan 2, 1904
#Iron Age 3 C.	76	1223	Nov. 3, 1905
Western Elect. 3 C.	34	38	Jan. 9, 1904
#Machinery	10	305	Feb. 1904

#Some theoretical and practical considerations of steam turbines
(E. Hodgkinson)

A.S.M.E.	25	715	1904

ZOELLY.

Zoelly steam turbines

#Electrical World 4 C.	43	1123	June 11, 1904
#Engineering 8 C.	77	770	June 3, 1904
#Engineering Record 4 C.	49	707	June 4, 1904
#Western Elect. 3 C.	36	265	Apr. 8, 1905
#Machinery 6 C.	10	631	Aug. 1904

DEVELOPMENT.

#Development of the steam turbine (S.Bull)
Engineer U.S.A. 1 C. 42 : 437 July 1, 1905

Discussion on the steam turbine at the A.S.M.E. meeting
Electrical World 3 C. 43 : 1086 June 4, 1904

#Development of the steam turbine (F. C. Perkins)
Western Elect. 5 C. 33 : 211 Sept. 19, 1903
4 C. 230 Sept. 26, 1903
2 C. 249 Oct. 3, 1903

EFFICIENCY.

Steam turbine efficiency (W. T. Edwards)
American Elect. 1 C. 15 : 255 June 1903

Steam turbine efficiency (Editorial)
Power 2 C. 24 : 179 Mch. 1904

Steam consumption of the turbine
Western Electrician 1 C. 32 : 489 June 20, 1903

Dynamic and commercial economy in turbines (R. H. Smith)
Engineer (Lond) 3 C. 97 : 540 May 27, 1904
4 C. 578 June 10, 1904
4 C. 608 June 17, 1904

Why the steam turbine is not more efficient (R.M.Nielson)
Power 26 : 83 Feb. 1906

DEVELOPMENT.

Development of the steam turbine (S.Bull)
Engineer U.S.A. 1 C. 42 : 437 July 1, 1904

Discussion on the steam turbine at the A.S.M.E. meeting
Electrical World 3 C. 43 : 1086 June 4, 1904

Development of the steam turbine (R. C. Perkins)
Western Elect. 5 C. 33 : 211 Sept. 19, 1903
4 C. 230 Sept. 26, 1903
2 C. 249 Oct. 3, 1903

EFFICIENCY.

Steam turbine efficiency (W. T. Edwards)
American Elect. 1 C. 15 : 255 June 1903

Steam turbine efficiency (Editorial)
Power 2 C. 24 : 179 Mch. 1904

Steam consumption of the turbine
Western Electrician 1 C. 32 : 489 June 20, 1903

Dynamic and commercial economy in turbines (R. H. Smith)
Engineer (Lond) 3 C. 97 : 540 May 27, 1904
4 C. 578 June 10, 1904
4 C. 608 June 17, 1904

Why the steam turbine is not more efficient (R.M.Wilson)
Power 26 : 83 Feb. 1903

EXHAUST STEAM TURBINES.

Steam turbine using exhaust steam
Electrical Age 1 C. 33 : 76 July 1904

Exhaust steam turbines in steel works
Electrical Age 1 C. 34 : 28 Jan. 1905

Steam turbines for utilizing exhaust steam
Engineering 2 C. 75 : 743 June 5, 1903

Utilization of exhaust steam in low pressure steam turbines (L. Battu)
Engineering News 4 C. 52 : 282 Sept. 29, 1904
#Jour. Western Soc.Eng. 31pp 9 : 474 1904

#Rateau steam turbine as an exhaust steam utilizer (A.Rateau)
Engineering Record 6 C. 49 : 508 Apr. 23, 1904

FLOOR SPACE.

Steam turbine floor economy
Cassier's Magazine 1 C. 24 : 175 June 1903
#Electrical Age 3 C. 32 : 27 Feb. 1904

GOVERNING.

#Electric governing of steam turbines
Western Electrician 3 C. 34 : 69 Jan. 23, 1904

INSTALLATIONS.

CURTIS

Steam turbines in Japan
Western Elect. 1 C. 37 : 126 Aug. 12, 1905

#Turbine power stations of the Terre Haute Traction & Light Co.
Engineering Record 6 C. 51 : 141 Feb. 4, 1905

EXHAUST STEAM TURBINES.

Steam turbine using exhaust steam
Electrical Age 1 C. 33 : 76 July 1904

Exhaust steam turbines in steel works
Electrical Age 1 C. 34 : 28 Jan. 1905

Steam turbines for utilizing exhaust steam
Engineering 2 C. 75 : 743 June 5, 1903

Utilization of exhaust steam in low pressure steam turbines
(L. Batty)
Engineering News 4 C. 52 : 282 Sept. 29, 1904
#Tour. Western Soc.Eng. 3Ipp 9 : 474 1904

#Rateau steam turbine as an exhaust steam utilizer (A.Rateau)
Engineering Record 6 C. 49 : 508 Apr. 23, 1904

FLOOR SPACE.

Steam turbine floor economy
Cassier's Magazine 1 C. 24 : 175 June 1903
#Electrical Age 3 C. 32 : 27 Feb. 1904

GOVERNING.

#Electric governing of steam turbines
Western Electrician 3 C. 34 : 69 Jan. 23, 1904

INSTALLATIONS.

CURTIS

Steam turbines in Japan
Western Elect. 1 C. 37 : 126 Aug. 12, 1905

#Turbine power stations of the Terre Haute Traction & Light Co.
Engineering Record 6 C. 51 : 141 Feb. 4, 1903

#Power station of the Detroit Edison Co.
Engineering Record 52 : 394 Oct. 7, 1905

#Stations of the Edison Electric Illuminating Co.
Engineering Record 11 C 51 : 150 Feb. 11, 1905
#Power 16 C. 25 : 389 July 1905
#Western Elect. 4 C. 34 : 409 May 21, 1904

#New York Central power stations
Engineering Record 52 : 535 Nov. 11, 1905
#St. Ry. Journal 26 : 876 Nov. 11, 1905

#Station of the Western Penn. Ry. & Light System
St. Ry. Journal 22 : 422 Sept. 5, 1903

#Turbine station of the Old Colony St. Ry.
St. Ry. Journal 25 : 1025 June 10, 1905

#Fisk St. Station, Chicago Edison Co.
Western Elect. 3 C. 32 : 296 May 23, 1903
" " 2 C. 34 : 53 Jan. 16, 1904
87 Jan. 30, 1904
Iron Age 7 C. 71 : 14 June 18, 1903

#Central station with steam and water turbines, Zanesville, Ohio
Engineering Record 3 C. 40 : 366 Mch. 19, 1904

#Steam turbine of the Mass. Electric Co.
St. Ry. Journal 7 C. 13 : 77 Feb. 20, 1903
16 C. 13 : 961 Dec. 20, 1903
Machinery 4 C. 10 : 130 Nov. 1903

#Curtis turbine at the Port Huron Light & Power Co.
Electrical World 11 C. 43 : 681 Apr. 9, 1904
#Engineering Record 5 C. 49 : 458 Apr. 9, 1904

#Power station of the Detroit Edison Co.
Engineering Record 52 : 394 Oct. 7, 1905

#Stations of the Edison Electric Illuminating Co.
Engineering Record 11 C 51 : 150 Feb. 11, 1905
#Power 16 C. 25 : 389 July 1905
#Western Elect. 4 C. 34 : 409 May 21, 1904

#New York Central power stations
Engineering Record 52 : 585 Nov. 11, 1905
#St. Ry. Journal 26 : 876 Nov. 11, 1905

#Station of the Western Penn. Ry. & Light System
St. Ry. Journal 22 : 422 Sept. 5, 1903

#Turbine station of the Old Colony St. Ry.
St. Ry. Journal 25 : 1025 June 10, 1905

#Fisk St. Station, Chicago Edison Co.
Western Elect. 3 C. 32 : 296 May 23, 1903
" " 2 C. 34 : 53 Jan. 16, 1904
87 Jan. 30, 1904
Iron Age 7 C. 71 : 14 June 18, 1903

#Central station with steam and water turbines, Zanesville, Ohio
Engineering Record 3 C. 40 : 366 Mch. 19, 1904

#Steam turbine of the Mass. Electric Co.
St. Ry. Journal 7 C. 13 : 77 Feb. 20, 1903
16 C. 13 : 961 Dec. 20, 1903
Machinery 4 C. 10 : 130 Nov. 1903

#Curtis turbine at the Port Huron Light & Power Co.
Electrical World 11 C. 43 : 681 Apr. 9, 1904
#Engineering Record 5 C. 49 : 458 Apr. 9, 1904

DE LAVAL

#Municipal electrical plant, Jacksonville, Fla.
Iron Age 4 C. 74 : 9 July 21, 1904
Machinery 2 C. 10 : 634 Aug. 1904

#Performance of a plant with heating with the exhaust of a condensing steam turbine
Engineering Record 5 C. 50 : 279 Sept. 3, 1904

#Steam turbine power plant at a Poughkeepsie shop
Engineering Record 6 C. 51 : 454 Apr. 22, 1905

#Power plant of the Mexican Central R.R.
Power 4 C. 23 : 709 Dec. 1903

#Anheuser Busch power plant
Power 1 C. 25 : 85 Feb. 1905

PARSONS.

#English steam turbine electric plant
Electrical World 35 : 313 Mch. 3, 1900

#Manchester steam turbine plant
Electrical World 41 : 983 June 6, 1903

Chelsea power station, London Underground
#Power 5 C. 23 : 421 Aug. 1903
#Power 25 : 174 Mch. 1905
#St. Ry. Journal 4 C. 25 : 393 Mch. 4, 1905

#Steam turbines in British generating stations
Western Elect. 2 C. 32 : 499 June 27, 1903

#Turbine power plant at Neuchatel, Switzerland
Western Elect. 4 C. 33 : 440 Dec. 12, 1903

#Power plant of De Beers Consolidated Mines Co. (A.F.Williams)
Engineering Record 11 C. 51 : 4 Jan. 2, 1905

#A 10000 H.P. steam turbine at Essen, Germany (F. Koester)
Power 4 C. 25 : 406 July 1905

DE LAVAL

#Municipal electrical plant, Jacksonville, Fla.
Iron Age 4 C. 74 : 9 July 21, 1904
Machinery 2 C. 10 : 634 Aug. 1904

#Performance of a plant with heating with the exhaust of a condensing steam turbine
Engineering Record 5 C. 50 : 279 Sept. 3, 1904

#Steam turbine power plant at a Pittsburg coal mine
Engineering Record 6 C. 51 : 454 Apr. 22, 1905

#Power plant of the Mexican Central R.R.
Power 4 C. 23 : 709 Dec. 1903

#Anheuser Busch power plant
Power 1 C. 25 : 85 Feb. 1905

PARSONS.

#English steam turbine electric plant
Electrical World 35 : 313 Mch. 3, 1900

#Manchester steam turbine plant
Electrical World 41 : 983 June 6, 1903

Chelsea power station, London Underground
#Power 5 C. 23 : 421 Aug. 1903
#Power 25 : 174 Mch. 1905
#St. Ry. Journal 4 C. 25 : 393 Mch. 4, 1905

#Steam turbines in British generating stations
Western Elect. 2 C. 32 : 499 June 27, 1903

#Turbine power plant at Neuchatel, Switzerland
Western Elect. 4 C. 33 : 440 Dec. 12, 1903

#Power plant of De Beers Consolidated Mines Co. (A.E.Williams)
Engineering Record 11 C. 51 : 4 Jan. 2, 1905

#A 10000 H.P. steam turbine at Essen, Germany (E. Koester)
Power 4 C. 25 : 406 July 1905

#1000 K.W. turbine
Engineer U.S.A. 2 C. 38 : 55 Feb. 1, 1901

WESTINGHOUSE-PARSONS.
Steam turbine for the Philadelphia subway
Iron Age 1 C. 71 : 31 June 18, 1903

Trubines for N.Y. Edison
St. Ry. Journal 26 : 157 July 22, 1905

#Hartford Steam turbine installation (P. C. Percy)
American Elect. 5 C. 14 : 277 June 1902

Steam turbine installation of the B.F.Goodrich Co., Akron, Ohio
#American Elect. 11 C. 15 : 539 Nov. 1903
#Engineering Record 12 C. 48 : 548 Nov. 7, 1903

#Steam turbine of the Rockland Light & Power Co.
Amer. Elect. 10 C. 16 : 169 Apr. 1904

#Power plant for the Boston Navy Yard
Electrical Age 2 C. 32 : 249 Apr. 1904

#Citizens Light, Heat & Power Co.
Electrical World 44 : 376 Sept. 3, 1904

#Municipal power plant at Anderson, Ind.
Engineer U.S.A. 42 : 641 Oct. 2, 1905

Turbine power plant of the New York, New Haven & Hartford R.R.
#Engineering Record 4 C. 51 : 73 Jan. 21, 1905
#St. Ry. Journal 4 C. 25 : 111 Jan. 21, 1905

#Dutch point plant of the Hartford Electric Light Co.
Engineering Record 7 C. 51 : 204 Feb. 25, 1905

Power plant of the Yale and Towne Mnfg. Co.
#Iron Age 6 C. 73 : 1 Apr. 21, 1904
#Power 7 C. 24 : 255 May 1904

#1000 K.W. turbine
Engineer U.S.A. 2 C. 38 : 55 Feb. 1, 1901

WESTINGHOUSE-PARSONS.
Steam turbine for the Philadelphia subway
Iron Age 1 C. 71 : 31 June 18, 1903

Turbines for N.Y. Edison
St. Ry. Journal 26 : 157 July 22, 1905

#Hartford Steam turbine installation (P. C. Percy)
American Elect. 5 C. 14 : 277 June 1902

Steam turbine installation of the B.T.Goodrich Co., Akron, Ohio
#American Elect. 11 C. 15 : 539 Nov. 1903
#Engineering Record 12 C.48 : 548 Nov. 7, 1903

#Steam turbine of the Rockland Light & Power Co.
Amer. Elect. 10 C. 16 : 169 Apr. 1904

#Power plant for the Boston Navy Yard
Electrical Age 2 C. 32 : 249 Apr. 1904

#Citizens Light, Heat & Power Co.
Electrical World 44 : 376 Sept. 3, 1904

#Municipal power plant at Anderson, Ind.
Engineer U.S.A. 42 : 641 Oct. 2, 1905

Turbine power plant of the New York, New Haven & Hartford R.R.
#Engineering Record 4 C. 51 : 75 Jan. 21, 1905
#St. Ry. Journal 4 C. 25 : 111 Jan. 21, 1905

#Dutch point plant of the Hartford Electric Light Co.
Engineering Record 7 C. 51 : 204 Feb. 25, 1905

Power plant of the Yale and Towne Mfg. Co.
#Iron Age 6 C. 73 : 1 Apr. 21, 1904
#Power 7 C. 24 : 255 May 1904

#Power plant of the Western Penn. Ry. & Light System
St. Ry. Journal 3 C. 22 : 422 Sept. 5, 1903

#Turbine equipment of the Elyria St. Ry. Co., Elyria, Ohio.
St. Ry. Journal 7 C. 23 : 164 Jan. 30, 1904

#Power station of the Manila Ry. System
St. Ry. Journal 25 : 770 Apr. 29, 1905

#Turbine stations of the Philadelphia R.T.Co.
St. Ry. ~~Journal~~ Review 15 : 531 Sept. 15, 1905

#Westinghouse Air Brake Co.
Western Elect. 5 C. 26 : 287 May 5, 1900
Engineering Record 7 C. 41 : 422 May 5, 1900

#W.-P. turbine at Sherwin-Williams Paint factory
Electrical World 6 C. 44 : 432 Sept. 10, 1904

#Power plant of the Western Penn. Ry. & Light System
St. Ry. Journal 3 C. 22 : 422 Sept. 5, 1903

#Turbine equipment of the Elyria St. Ry. Co., Elyria, Ohio.
St. Ry. Journal 7 C. 25 : 164 Jan. 30, 1904

#Power station of the Manila Ry. System
St. Ry. Journal 25 : 770 Apr. 29, 1905

#Turbine stations of the Philadelphia R.T.Co.
St. Ry. Journal C 15 : 531 Sept. 15, 1905

#Westinghouse Air Brake Co.
Western Elect. 5 C. 26 : 287 May 5, 1900
Engineering Record 7 C. 41 : 422 May 5, 1900

#W.-P. turbine at Sherwin-Williams Paint factory
Electrical World 6 C. 44 : 432 Sept. 10, 1904

Marine steam turbine and its application to the propulsion of vessels. (C. A. Parsons)

Engineering	8 C.	76 : 43, 48	July 10, 1903
		101	July 17, 1903

Steam turbines in destroyers

Engineering	5 C.	78 : 53	July 8, 1904

#Turbines in Midland Ry. Co. steam ship service

Engineering	6 C.	78 : 499	Oct. 14, 1904

Future of steam turbines

Engineering	4 C.	78 : 719	Nov.25, 1904

Turbines and reciprocating engine (W. Gray)

Engineering	4 C.	80 : 161	Aug. 4, 1905
Engineering Mag.	4 C.	29 : 935	Sept. 1905

Steam turbine as applied to ocean liners (Biles)

Engineering News	5 C.	54 : 423	Oct. 26, 1905

Steam turbines for the United States Navy

Iron Age	3 C.	72 : 18	Sept. 17, 1903
	1 C.	72 : 9	Oct. 22, 1903
	5 C.	72 : 15	Dec.3, 1903

Curtis steam turbine for marine propulsion

Engineering		76 : 806	Dec. 11, 1903

Rateau steam turbine

Engineering	3 C.	77 : 462	Apr. 1, 1904
	4 C.	77 : 515	Apr. 8, 1904

Parsons steam turbine in H.M.S. "Viper"

Engineering	2 C.	69 : 218	Feb.16, 1900
	2 C.	625	May 11, 1900

Marine steam turbine and its application to the propulsion of vessels. (C. A. Parsons)

Engineering 8 C. 76 : 43, 48 July 10, 1903
103 July 17, 1903

Steam turbines in destroyers

Engineering 5 C. 78 : 53 July 8, 1904

#Turbines in Midland Ry. Co. steam ship service

Engineering 6 C. 78 : 499 Oct. 14, 1904

Future of steam turbines

Engineering 4 C. 78 : 719 Nov.25, 1904

Turbines and reciprocating engine (W. Gray)

Engineering 4 C. 80 : 161 Aug. 4, 1905
Engineering Mag. 4 C. 29 : 935 Sept. 1905

Steam turbine as applied to ocean liners (Biles)

Engineering News 5 C. 54 : 423 Oct. 26, 1905

Steam turbines for the United States Navy

Iron Age 3 C. 72 : 18 Sept. 17, 1903
1 C. 72 : 9 Oct. 22, 1903
5 C. 72 : 15 Dec.3, 1903

Curtis steam turbine for marine propulsion

Engineering 76 : 806 Dec. 11, 1903

Rateau steam turbine

Engineering 3 C. 77 : 462 Apr. 1, 1904
4 C. 77 : 515 Apr. 8, 1904

Parsons steam turbine in H.M.S. "Viper"

Engineering 2 C. 69 : 218 Feb.16, 1900
2 C. 625 May 11, 1900

MANUFACTURE

CURTIS.

Curtis steam turbine; British-Thompson-Houston works
Engineering 4 C. 79 : 648 May 10, 1905

#Making a small Curtis turbine
Power 18 C. 25 : 74 Feb. 1905

#The Curtis steam turbine and its manufacture
Machinery 10 C. 10 : 1 Sept. 1903

DE LAVAL

#The De Laval steam turbine Co.
Machinery 14 C. 11 : 6 Oct. 1904

#The De Laval steam turbine and its manufacture
Machinery 14 C. 11 : 123 Nov. 1904

PARSONS

#Richardson, Westgaret & Co's steam turbine works
Engineering 4 C. 80 : 471 Oct. 19, 1905

RIEDLER-STUMPF

#Steam turbine construction (O. Lasche)
Engineering 7 C. 78 : 231 Aug. 19, 1904
8 C. 329 Sept. 9, 1904
#Power 15 C. 24 : 577 Oct. 1904

MARINE TURBINES.

Advantages of the steam turbine as a marine engine
Cassier's Magazine 7 C. 25 : 95 Nov. 1903

Future for the steam turbine
Cassier's Magazine 1 C. 28 : 83 May 1905

Reversing steam turbines
Engineering 1 C. 74 : 819 Dec. 19, 1902

MANUFACTURE

CURTIS.

Curtis steam turbine; British-Thompson-Houston works
Engineering 4 C. 79 : 648 May 10, 1905

#Making a small Curtis turbine
Power 18 C. 25 : 74 Feb. 1905

#The Curtis steam turbine and its manufacture
Machinery 10 C. 10 : 1 Sept. 1903

DE LAVAL

#The De Laval steam turbine Co.
Machinery 14 C. 11 : 6 Oct. 1904

#The De Laval steam turbine and its manufacture
Machinery 14 C. 11 : 123 Nov. 1904

PARSONS

#Richardson, Westgaret & Co's steam turbine works
Engineering 4 C. 80 : 471 Oct. 19, 1905

RIDDER-STUMPF

#Steam turbine construction (O. Laasche)
Engineering 7 C. 78 : 251 Aug. 19, 1904
8 C. 329 Sept. 9, 1904
#Power 15 C. 24 : 577 Oct. 1904

MARINE TURBINES.

Advantages of the steam turbine as a marine engine
Cassier's Magazine 7 C. 25 : 95 Nov. 1903

Future for the steam turbine
Cassier's Magazine 1 C. 28 : 83 May 1905

Reversing steam turbines
Engineering 1 C. 74 : 819 Dec. 19, 1902

OPERATION.

Emergency starting of a steam turbine and a reciprocating engine (A.S.Mann)

Electrical Age 4 C.	34 : 478	June 1905
Engineer U.S.A. 2 C.	42 : 414	June 15, 1905
Engineering 2 C.	80 : 332	Sept. 8, 1905
Engineering Record 2 C.	51 : 661	June 10, 1905

Steam turbine from an operating standpoint (F. A. Waldron)

Engineering News 5 C.	49 : 569	June 25, 1903
A.S.M.E. 37 pp.	24 : 999	1903

Steam turbines in America

Engineering Record 6 C.	51 : 703	June 24, 1905

Steam turbine in practice

Power 4 C.	24 : 67	Feb. 1904

Steam turbines (S.E.Fedden)

St. Ry. Journal 3 C.	12 : 831	Nov. 20, 1902
Western Elect. 2 C.	31 : 125	Aug. 23, 1902
Electrical Engineer Lond	30 : 47	Apr. 11, 1902
#Engineer U.S.A. 3 C.	39 : 627	Sept. 15, 1902

Steam turbine power plants (J. R. Bibbins)

Engineering Record 5 C.	50 : 464	Oct. 15, 1904
Power 24 C.	25 : 20	Jan. 1905
Western Elect. 5 C.	35 : 334	Oct. 22, 1904

Operating features of vertical Curtis turbines (A. H. Kruesi)

Electrical World	45 : 1088	June 10, 1905
#Engineering Record 8 C.	52 : 8	July 1, 1905
Western Elect. 2 C.	36 : 503	June 24, 1905

Operation of the Rateau turbine

St. Ry. Journal 2 C.	22 : 118	July 25, 1903

OPERATION.

Emergency starting of a steam turbine and a reciprocating engine
(A.S.Mann)

Electrical Age 4 C.	34	478	June 1905
Engineer U.S.A. 2 C.	42	414	June 16, 1905
Engineering 2 C.	80	332	Sept. 8, 1905
Engineering Record 2 C.	51	601	June 10, 1905

Steam turbine from an operating standpoint (F. A. Waldron)

Engineering News 5 C.	49	569	June 25, 1903
A.S.M.E.	37 pp.	24	999 1903

Steam turbines in America

Engineering Record 6 C.	51	703	June 24, 1905

Steam turbine in practice

Power 4 C.		24	67 Feb. 1904

Steam turbines (S.H.Pedden)

St. Ry. Journal 3 C.	12	831	Nov. 20, 1902
Western Elect. 2 C.	31	125	Aug. 23, 1902
Electrical Engineer London30		47	Apr. 11, 1902
#Engineer U.S.A. 3 C.	39	627	Sept. 15, 1902

Steam turbine power plants (I. R. Bibbins)

Engineering Record 5 C.	50	464	Oct. 15, 1904
Power 24 C.		25 : 20	Jan. 1905
Western Elect. 5 C.	35	334	Oct. 22, 1904

Operating features of vertical Curtis turbines (A. H. Kruesi)

Electrical World	45	1088	June 10, 1905
#Engineering Record 8 C.	52	8	July 1, 1905
Western Elect. 2 C.	36	503	June 24, 1905

Operation of the Batsen turbine

St. Ry. Journal 2 C.	22	118	July 25, 1903

PROGRESS.

#Progress in the introduction of the steam turbine (J.R.Bibbins)
Engineering Magazine 13pp 24 : 745 Feb. 1903

STARTING.
See Operation.

TESTS.
CURTIS.

Tests of steam turbines at the Newport station
Engineering Record 4 C. 49 : 602 Apr. 16, 1904
624 May 14, 1904

Curtis steam turbine test
Electrical World 1 C. 44 : 1025 Dec. 10, 1904

Test of 500 K.W. Curtis turbine set at Cork
St. Ry. Journal 2 C. 24 : 989 Dec. 3, 1904
Electrical World 1 C. 44 : 1025 Dec. 10, 1904
Engineering 2 C. 78 : 679 Nov. 18, 1904

Test of 500 K.W. Curtis turbine
Electrical World 1 C. 45 : 875 May 13, 1905

Tests on a 2000 K.W. Curtis turbine at Schnectaday
American Elect. 1 C. 17 : 446 Aug. 1905
Engineering News 1 C. 54 : 79 July 20, 1905
#St. Ry. Journal 1 C. 26 : 150 July 22, 1905
#St. Ry. Review 1 C. 15 : 488 Aug. 15, 1905
Western Elect. 1 C. 37 : 71 July 22 , 1905

Steam turbine tests in commercial service, Tests by Mr.Barrus
Engineering Record 3 C. 49 : 624 May 14, 1904
Iron Age 1 C. 73 : 31 May 5, 1905

PROGRESS.

#Progress in the introduction of the steam turbine (J.R.Bibbins)
Engineering Magazine 13pp 24 : 745 Feb. 1903

STARTING.
See Operation.

TESTS.
CURTIS.
Tests of steam turbines at the Newport station
Engineering Record 4 C. 49 : 602 Apr. 16, 1904
624 May 14, 1904

Curtis steam turbine test
Electrical World 1 C. 44 : 1025 Dec. 10, 1904

Test of 500 K.W. Curtis turbine set at Cork
St. Ry. Journal 2 C. 24 : 989 Dec. 3, 1904
Electrical World 1 C. 44 : 1025 Dec. 10, 1904
Engineering 2 C. 78 : 679 Nov. 18, 1904

Test of 500 K.W. Curtis turbine
Electrical World 1 C. 45 : 875 May 13, 1905

Tests on a 2000 K.W. Curtis turbine at Schnectady
American Elect. 1 C. 17 : 446 Aug. 1905
Engineering News 1 C. 54 : 79 July 20, 1905
#St. Ry. Journal 1 C. 26 : 180 July 22, 1905
#St. Ry. Review 1 C. 15 : 488 Aug. 15, 1905
Western Elect. 1 C. 37 : 71 July 22, 1905

Steam turbine tests in commercial service, Tests by Mr.Barrus
Engineering Record 3 C. 49 : 624 May 14, 1904
Iron Age 1 C. 73 : 31 May 5, 1905

DE LAVAL.

De Laval turbine using superheated steam
Engineering News 2 C. 47 : 318 Apr. 17, 1902
" Record 4 C. 46 : 100 Aug. 2, 1902

DeLaval turbine test
Engineering Record 44 : 152 Aug. 17, 1901

#Test of a De Laval steam turbine
American Electrician 3 C 17 : 445 Aug. 1905

Steam turbine test after two years service
#Engineer U.S.A. 3 C. 42 : 526 Aug. 1, 1905
#Electrical World 1 C. 46 : 111 July 15, 1905
#Engineering Record 2 C. 52 : 76 July 15, 1905
Iron Age 1 C. 76 : 3 July 6, 1905

Test of a 15 H.P. steam turbine
Engineering & Mining Journal 78 : 706 Nov. 3, 1904

Test of a 300 H.P. turbine dynamo
St. Ry. Journal 2 C. 20 : 405 Sept. 20, 1902

Test of turbine pumps
Machinery 1 C. 10 : 650 Aug. 1904

#Efficiency test of a direct connected steam turbine for a blower set (C. R. Walker)
Engineering News 6 C. 53 : 62 Jan. 19, 1905

DE LAVAL.

De Laval turbine using superheated steam

Engineering News 2 C. 47 : 318 Apr. 17, 1902
" Record 4 C. 46 : 100 Aug. 2, 1902

Delaval turbine test

Engineering Record 44 : 152 Aug. 17, 1901

*Test of a De Laval steam turbine

American Electrician 3 C 17 : 445 Aug. 1905

Steam turbine test after two years service

*Engineer U.S.A. 3 C. 42 : 526 Aug. 1, 1905
*Electrical World 1 C. 46 : 111 July 15, 1905
*Engineering Record 2 C. 52 : 76 July 15, 1905
Iron Age 1 C. 76 : 3 July 6, 1905

Test of a 15 H.P. steam turbine

Engineering & Mining Journal 78 : 706 Nov. 3, 1904

Test of a 300 H.P. turbine dynamo

St. Ry. Journal 2 C. 20 : 405 Sept. 20, 1902

Test of turbine pumps

Machinery 1 C. 10 : 650 Aug. 1904

*Efficiency test of a direct connected steam turbine for a blower

set (C. R. Walker)

Engineering News 6 C. 53 : 62 Jan. 19, 1905

MISCELLANEOUS.

Trubine progress
Engineer U.S.A. 3 C. 42 : 483 July 15, 1905

Notes on the steam turbine (H. F. Schmidt)
St. Ry. Journal 6 C. 23 : 963 June 25, 1904

Testing the capacity of turbines (E.P.Burch)
Electrical World 2 C. 36 : 955 Dec. 22, 1900

PARSONS.

Test of a 1000 K.W. Parsons steam turbine
#Engineering 2 C. 70 : 830 Dec.28, 1900
#Engineering Record 2 C. 43 : 80 Jan. 26, 1901

Test of steam turbine for driving dynamos (Parsons and Stoney)
Engineering 6 C. 72 : 339 Sept. 6, 1901

#English records of Parsons steam turbines (Parsons)
St. Ry. Journal 23 : 859 June 4, 1904

#Steam turbines in Europe (E. Guarni)
Power 5 C. 23 : 676 Dec. 1903

Trials of steam turbines (C. A. Parsons)
American Elect. 1 C. 13 : 539 Nov. 1901

Tests of a Parsons at Sheffield
Engineering 2 C. 79 : 324 Mch. 10, 1905

Test of a direct connected steam turbine and generator after one year of use.
Engineering Record 44 : 64 July 20, 1901

#Test of a turbine at Neuchatel
Engineering Record 4 C. 49 : 706 June 4, 1904
Machinery 4 C. 10 : 455 May 1904

MISCELLANEOUS.

Turbine progress

Engineer U.S.A. 3 C. 42 : 483 July 15, 1905

Notes on the steam turbine (H. T. Schmidt)

St. Ry. Journal 6 C. 23 : 963 June 25, 1904

Testing the capacity of turbines (E.P.Burch)

Electrical World 2 C. 36 : 955 Dec. 22, 1900

PARSONS.

Test of a 1000 K.W. Parsons steam turbine

#Engineering 2 C. 70 : 830 Dec.28, 1900

#Engineering Record 2 C. 43 : 80 Jan. 26, 1901

Test of steam turbine for driving dynamos (Parsons and Stoney)

Engineering 6 C. 72 : 339 Sept. 6, 1901

#English records of Parsons steam turbines (Parsons)

St. Ry. Journal 23 : 859 June 4, 1904

#Steam turbines in Europe (E. Swarnt)

Power 5 C. 23 : 676 Dec. 1903

Trials of steam turbines (C. A. Parsons)

American Elect. 1 C. 13 : 539 Nov. 1901

Tests of a Parsons at Sheffield

Engineering 2 C. 79 : 324 Mch. 10, 1905

Test of a direct connected steam turbine and generator after one year of use.

Engineering Record 44 : 64 July 20, 1901

#Test of a turbine at Neuchatel

Engineering Record 4 C. 49 : 706 June 4, 1904

Machinery 4 C. 10 : 455 May 1904

WESTINGHOUSE-PARSONS.

Steam turbine (F. Hodgkinson)
Engineer U.S.A. 6 C. 41 : 224 Mch. 15, 1904

Steam turbine performance (J. R. Bibbins)
Engineer U.S.A. 10 C. 41 : 802 Dec. 1, 1904
850 Apr. 15, 1904

Test of turbines for the Cleveland, Elyria and Western Ry.
St. Ry. Journal 2 C. 22 : 1063 Dec. 19, 1903

Test of a Westinghouse-Parsons turbine
Electrical World 1 C. 43 : 1162 June 18, 1904

#Test of Parsons turbines
Electrical World 4 C. 43 : 1084 June 4, 1904

Turbine testing plant of the Westinghouse Machine Co.
#Engineering Record 6 C. 50 : 372 Sept. 24, 1904
#Engineering News 9 C. 51 : 213 Mch. 3, 1904

Efficiency test of 1250 K.W. Westinghouse-Parsons turbines for the Interborough plant (A. M. Mattice)
#Power 16 C. 24 : 127 Mch. 1904
Engineering Record 3 C. 49 : 232 Feb. 20, 1904
#Electrical World 9 C. 43 : 356 Feb. 20, 1904
Iron Age 1 C. 73 : 19 Mch. 17, 1904

Test of a 400 K.W. Westinghouse-Parsons turbine
#Power 2 C. 24 : 239 Apr. 1904
St. Ry. Journal 23 : 906 June 11, 1904
Electrical World 43 : 1162 June 18, 1904

Test of a 400 K.W. W.-P. turbine at Yale and Towne Co's plant (F. A. Waldron)
St. Ry. Journal 3 C. 21 : 939 June 27, 1903
Engineering Record 5 C. 47 : 698 June 11, 1904

Test of a 400 K.W. Westinghouse-Parsons turbine
Electrical World 2 C. 45 : 1069 June 10, 1905
Engineer U.S.A. 1 C. 42 : 455 June 1, 1905
Engineering Record 3 C. 51 : 665 June 10, 1905
Power 4 C. 25 : 466 Aug. 1905
St. Ry. Journal 1 C. 25 : 1037 June 10, 1905
St. Ry. Review 2 C. 15 : 498 Aug. 15, 1905

Tests of steam turbine installed at Hartford (W.L.Robb)
Electrical World 2 C. 40 : 360 Sept. 6, 1902

Tests of steam turbines
Engineering 5 C. 78 : 559 Oct. 21, 1904

WESTINGHOUSE-PARSONS.

Steam turbine (E. Hodgkinson)

Engineer U.S.A. 6 C.	41	224	Mch. 15, 1904

Steam turbine performance (J. R. Bibbins)

Engineer U.S.A. 10 C.	41	802	Dec. 1, 1904
		850	Apr. 15, 1904

Test of turbines for the Cleveland, Elyria and Western Ry.

St. Ry. Journal 2 C.	22	1063	Dec. 10, 1903

Test of a Westinghouse-Parsons turbine

Electrical World 1 C.	43	1162	June 18, 1904

#Test of Parsons turbines

Electrical World 4 C.	43	1084	June 4, 1904

Turbine testing plant of the Westinghouse Machine Co.

#Engineering Record 6 C.	50	372	Sept. 24, 1904
#Engineering News 9 C.	51	213	Mch. 3, 1904

Efficiency test of 1250 K.W. Westinghouse-Parsons turbines for the Interborough plant (A. M. Mattice)

#Power 16 C.	24	127	Mch. 1904
Engineering Record 3 C.	49	232	Feb. 20, 1904
#Electrical World 9 C.	43	356	Feb. 20, 1904
Iron Age 1 C.	73	19	Mch. 17, 1904

Test of a 400 K.W. Westinghouse-Parsons turbine

#Power 2 C.	24	239	Apr. 1904
St. Ry. Journal	23	906	June 11, 1904
Electrical World	43	1162	June 18, 1904

Test of a 400 K.W. W.-P. turbine at Yale and Towne Co's plant (T. A. Waldron)

St. Ry. Journal 3 C.	21	939	June 27, 1903
Engineering Record 5 C.	47	698	June 11, 1904

Test of a 400 K.W. Westinghouse-Parsons turbine

Electrical World 2 C.	45	1069	June 10, 1905
Engineer U.S.A. 1 C.	43	455	June 1, 1905
Engineering Record 3 C.	51	665	June 10, 1905
Power 4 C.	25	466	Aug. 1905
St. Ry. Journal 1 C.	25	1037	June 10, 1905
St. Ry. Review 2 C.	15	498	Aug. 15, 1905

Tests of steam turbine installed at Hartford (W.L.Robb)

Electrical World 2 C.	40	360	Sept. 6, 1902

Tests of steam turbines

Engineering 5 C.	78	559	Oct. 21, 1904

Test of a 1000 K.W. turbine under service conditions
Engineering Record 2 C. 52 : 134 July 29, 1905

#Test of a steam turbine (F.E.Cardullo)
Sibley Journal 8 PP. 15 : 390 June 1901

THEORY.
Steam turbine problem (H.F.Schmidt)
American Electrician 16 : 76 Feb. 1904

THEORY (CON)
Steam turbine thermodynamics
Cassier's Magazine 2 C. 25 : 184 Dec. 1903

#The steam turbine (F. Hodgkinson)
Electrical World 9 C. 36 ; 952 Dec. 22, 1900
995 " 29, "
37 : 15 Jan. 5, 1901

Thurston on the steam turbine
Electrical World 2 C. 41 : 516 Mch. 28, 1903
Engineer U.S.A. 1 C. 37 : 233 Sept. 15, 1900
St. Ry. Journal 1 C. 10 : 736 Dec. 15, "

#Steam turbines (con.art) (H. Boyd Brydon)
Engineer U:S.A. 41 : 201 Mch. 15, 1904
351 May 15, 1904
434 June 15,
597 Sept. 1,
755 Nov. 1,
836 Dec. 15,
42 : 149 Feb. 15, 1905
213 Mch. 15,

Test of a 1000 K.W. turbine under service conditions
Engineering Record 2 C. 52 : 134 July 29, 1905

#Test of a steam turbine (E.E.Cardullo)
Sibley Journal 8 PP. 15 : 390 June 1901

THEORY.
Steam turbine problem (W.W.Schmidt)
American Electrician 15 : 76 Feb. 1904

THEORY (CON)
Steam turbine thermodynamics
Cassier's Magazine 2 C. 25 : 184 Dec. 1903

#The steam turbine (W. Hodgkinson)
Electrical World 2 C. 36 ; 952 Dec. 22, 1900
995 " 29, "
37 : 15 Jan. 5, 1901

Thurston on the steam turbine
Electrical World 2 C. 41 : 516 Mch. 28, 1903
Engineer U.S.A. 1 C. 37 : 235 Sept. 15, 1900
St. Ry. Journal 1 C. 10 : 736 Dec. 15, "

#Steam turbines (con.art) (H. Boyd Brydon)
Engineer U:S.A. 41 : 201 Mch. 15, 1904
351 May 15, 1904
434 June 15,
597 Sept. 1,
755 Nov. 1,
836 Dec. 15,
42 : 149 Feb. 15, 1905
213 Mch. 15,

	288	Apr. 15,
	322	May 1,
	352	May 15,
	392	June 1,
	449	June 15,
	554	Aug. 15,

Diagrams of a compound steam turbine

Engineering 9 C.	79 : 37	Jan. 13, 1905
10 C.	137	Feb. 3, 1905

#Experiments on the escape of steam through orifices (Rateau)

Engineering News 2 C.	46 : 204	Sept. 19, 1905

The steam turbine (Storm Bull)

Engineering News 4 C.	53 : 619	June 15, 1905
#Jour. W.S.E. 28 pp.	10 : 526	June 7, 1905

#Multiple impact steam turbine (A.M.Levin)

Power 7 C.	24 : 300	May 1904

#The steam turbine (F.R.Low)

Power 12 C.	25 : 592	Oct. 1905

Indicating a steam turbine (W.H.Booth)

Cassier's Magazine 1 C.	26 : 427	Aug. 1904
Electrical Age 1 C.	33 : 75	July 1904

#Experiments on the efflux of steam

Engineering 3 C.	72 : 444	Sept. 27, 1901

Critical speed of the steam turbine (F. Needen)

St. Ry. Journal 1 C.	22 : 235	Aug. 15, 1903

Theroetical and practical considerations in steam turbine work (F. Hodgkinson)

Engineering News 10 C.	51 : 533	June 9, 1904
A.S.M.E. 66pp.	25 : 716	1904

Steam turbines

Power 3 C.	21 : 3	May 1901
#Power 5 C.	21 : 8	July 1901

Steam turbines to date (R. H. Thurston)

Power 4 C.	23 : 251	May 1903

#The DeLaval turbine

Power 5 C.	21 : 12	Nov. 1901

#The steam turbine

Machinery 5 C.	9 : 136	Nov. 1902

#Impulse and reaction turbines

Machinery 4 C.	11 : 346	Mch. 1905

	288	Apr. 15,
	322	May 1,
	352	May 15,
	392	June 1,
	440	June 15,
	554	Aug. 15,

Diagrams of a compound steam turbine

Engineering 9 C.	79 : 37	Jan. 13, 1905
10 C.	137	Feb. 3, 1905

#Experiments on the escape of steam through orifices (Rateau)

Engineering News 2 C.	46 : 204	Sept. 15, 1905

The steam turbine (Storm Bull)

Engineering News 4 C.	53 : 619	June 15, 1905
#Tour. W.S.E. 28 pp.	10 : 526	June 7, 1905

#Multiple impact steam turbine (A.M.Levin)

Power 7 C.	24 : 300	May 1904

#The steam turbine (F.R.Low)

Power 12 C.	25 : 592	Oct. 1905

Indicating a steam turbine (W.H.Booth)

Cassier's Magazine 1 C.	26 : 427	Aug. 1904
Electrical Age 1 C.	33 : 75	July 1904

#Experiments on the efflux of steam

Engineering 3 C.	72 : 444	Sept. 27, 1901

Critical speed of the steam turbine (E. Meeden)

St. Ry. Journal 1 C.	22 : 235	Aug. 15, 1903

Theoretical and practical consideration in steam turbine work (F. Hodgkinson)

Engineering News 10 C.	51 : 533	June 9, 1904
A.S.M.E. 66pp.	25 : 716	1904

Steam turbines

Power 3 C.	21 : 3	May 1901
#Power 5 C.	21 : 8	July 1901

Steam turbines to date (R. H. Thurston)

Power 4 C.	23 : 251	May 1903

#The Delaval turbine

Power 5 C.	21 : 12	Nov. 1901

#The steam turbine

Machinery 5 C.	9 : 136	Nov. 1902

#Impulse and reaction turbines

Machinery 4 C.	11 : 346	Jan. 1905

USES.
See applications

VACUUM.
Effect of Vacuum on the steam turbine (Editorial)
Power 1 C. 23 : 400 July 1903

Development of the Parsons steam turbine (C. A. Parsons)
Engineering 1 C. 77 : 718 May 20, 1904

Importance of a vacuum in the steam turbine
Engineering Record 1 C. 49 : 731 June 11, 1904
Power 1 C. 23 : 400 July 1903

USES.

See applications

VACUUM.

Effect of Vacuum on the steam turbine (Editorial)
Power I C. 23 : 400 July 1903

Development of the Parsons steam turbine (C. A. Parsons)
Engineering I C. 77 : 718 May 20, 1904

Importance of a vacuum in the steam turbine
Engineering Record I C. 49 : 731 June 11, 1904
Power I C. 23 : 400 July 1903